TOMATO SUSPENSION AGREEMENT: AN ANALYSIS OF U.S. FRESH TOMATO MARKET

by

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A Thesis Submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL & RESOURCE ECONOMICS

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

2017

STATEMENT BY AUTHOR

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Abstract

Tomatoes are a high value crop in the United States market, especially during the winter months when the main suppliers are Florida and Mexico, and this has created conflict within the industry, off and on, for nearly 50 years. Literature points to imported tomatoes as the cause of lower prices in the United States market (ERS-USDA 2016).

This thesis analyzes the effects of fresh tomato volumes both imported from Mexico and shipped from Florida on their shipping point prices and on terminal market prices in the United States. It also investigates the influence of the tomato suspension agreement on shipping point prices and on fresh tomato volumes in the United States, and to what extent temperature and precipitation have an impact on fresh tomatoes volumes.

This analysis utilizes historical information of 18 years (1998 – 2015) of tomato volumes in the United States market, prices free on board (F.O.B.) for point of origin sales, prices of wholesale market sales at three main terminal markets, gas prices, weather patterns in the main tomato growing regions of Florida and Mexico, and the Tomato Suspension Agreement floor prices for Mexican tomatoes.

The findings of this research show that the volume of Mexican tomatoes have no effect on shipping point prices of round tomatoes from Florida, and even more, neither affect the terminal market prices of round tomatoes from Florida at its main markets (New York and Chicago terminal markets). These findings contradict the accusations of Mexican tomatoes being dump in the market and lowering prices.

The results of this study suggest that by utilizing different growing methods (greenhouses) the Mexican tomato industry has been able to control for temperature changes that can decimate tomato production acquiring a competitive advantage over Florida tomato production.

Moreover, the findings suggest that the tomato suspension agreement floor prices affect in like manner volumes and prices of tomatoes from both Mexico and from Florida.

1.1 Introduction

Fresh tomatoes are one of the most popular vegetables (while tomatoes are botanically fruits, they are generally considered vegetables) in the United States, and they are demanded year-round by consumers; in 2013 the estimated consumption in the United States was 6.5 billion pounds (Cook, 2014). To meet the increasing demand for tomatoes, fresh tomato imports are necessary to supplement the United States seasonal supplies.

Florida and Mexico are the main suppliers of tomatoes to the United States during the winter season (December to April), accounting for more than 80 percent of the volume in the U.S. (Figure 1.1.1).

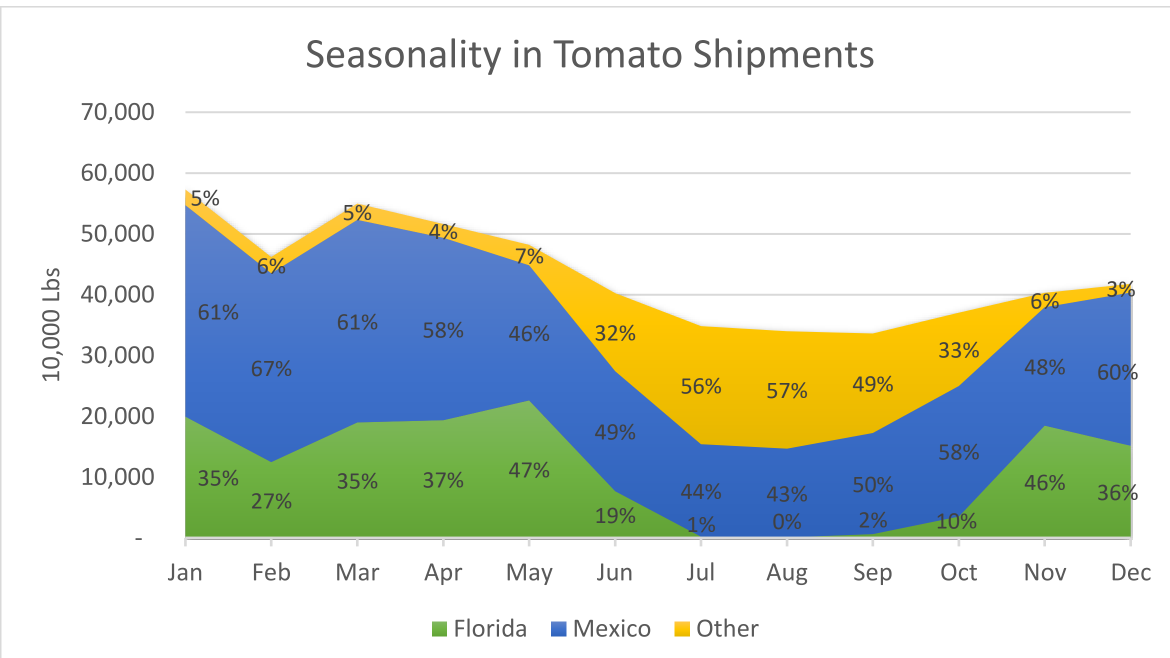


Figure 1.1.1 Seasonality in tomato shipments in the U.S. market by origin in 2015 (Source: USDA-AMS)

During the winter season, fresh tomatoes from Mexico are imported to provide mainly for the western United States. Most of Florida's winter crop is shipped to and consumed in the eastern United States (Boriss and Brunke, 2005).

Florida and Mexico compete for the United States market (Ames et al., 1996) and during winter season, Florida growers have accused Mexican growers of dumping (selling for less than the cost of production) fresh tomatoes in the U.S. market (Thompson, et al., 2005), and argue that the surge in Mexican tomato imports is a reason for the depressed domestic prices (Ames et al., 1996).

1.2 Tomato Suspension Agreement (TSA)

Fresh tomatoes during the winter months have been the center of many disputes in international commerce since the late 19th century (Ames et al, 1996). On April 1, 1996, the United States tomato industry filed an antidumping petition with the U.S. Department of Commerce alleging that Mexican tomatoes were sold in the U.S. market at less than a fair value (Rudman et al., 2013). This prompted Mexican tomato growers to sign an agreement with the United States government to stop the antidumping investigation, and agree to sell the tomatoes at or above a reference price for all fresh Mexican tomatoes exported to the United States. Mexican tomato exports destined for processing facilities are exempt from the Tomato Suspension Agreement.

On June 22, 2012, the U.S. tomato industry sought to withdraw their antidumping petition and terminate the investigation and the suspension agreement of 1996 and start a new tomato antidumping investigation that would set quotas or tariff on tomatoes from Mexico. However, negotiations for a revised agreement between Mexican tomato growers and the U.S. government began and a new tomato suspension agreement was in place by March 4, 2013 with new tomatoes categories and an increase of the reference prices as shown in table 1.2.1 that gives historical levels of reference prices set by the Tomato Suspension Agreement since its inception in 1996.

The tomato suspension agreement of 2013 sets different floor prices for Mexican fresh tomatoes during the summer and winter, and specifies prices for open field/adapted-environment and controlled-environment[1] production[2]. All exporters of Mexican tomatoes, growers and non-growers, exporting to the United States are signatories to the Agreement. According to Mexican growers, tomato exports have complied with the new tomato suspension agreement requirements (Flores and Lopez, 2015)[3].

Table 1.2.1 Historical Tomato Suspension Agreement Floor Prices through the Years[4]

	Tomatoes	
	July 1 - October 22	**October 23 - June 30**
	Dollars per lb.	**Dollars per lb.**
1996	$ 0.2068	$ 0.2068
2002	$ 0.1720	$ 0.2169
2008	$ 0.1720	$ 0.2169
2013	$ 0.2458	$ 0.3110

(Source: United States Department of Commerce – International Trade Administration)

The reference prices set by the tomato suspension agreement allow Mexican tomatoes to be sold at or above the reference prices. Thus, when the market price of tomatoes is below the reference price, Mexican tomatoes are prevented from commercial sales in the United States and are redirected to other markets, donated or destroyed. Figure 1.2.1 shows the annual market percentage of plum and round tomatoes in the U.S. by their origin.

[1] Controlled environment tomatoes are limited to those tomatoes grown in a fully-enclosed permanent aluminum or fixed steel structure clad in glass, impermeable plastic, or polycarbonate using automated irrigation and climate control, including heating and ventilation capabilities in an artificial medium using hydroponic methods.
[2] Suspension of Antidumping Investigation on Fresh Tomatoes from Mexico: Price per pound of Open Field and Adapted Environment, other than specialty – July 1 to October 22 $0.2458/lb, October 23 to June 30 $0.31/lb; Controlled environment, other than specialty – July 1 to October 22 $0.3251/lb, October 23 to June 30 $0.41/lb; Specialty, loose – July 1 to October 22 $0.3568/lb, October 23 to June 30 $0.45/lb; Specialty, packed – July 1 to October 22 $0.4679/lb, October 23 to June 30 $$0.59/lb. (Department of Commerce - Weight Charts, 2013)
[3] Signatories will fully comply with all requirements of Mexican regulations concerning identification, tracking, verification and inspection by the relevant Mexican authorities including 3 the Ministry of Economy (SECON), the Ministry of Agriculture (SAGARP A), SAGARPA's National Food Health, Safety and Quality Service (SENASICA) and Customs. In accordance with Mexican regulations, non-compliance will result in the revocation of export privileges (Department of Commerce – Suspension of Antidumping Investigation, 2013).
[4] Prices of tomatoes are of open field and adapted environment other than specialty.

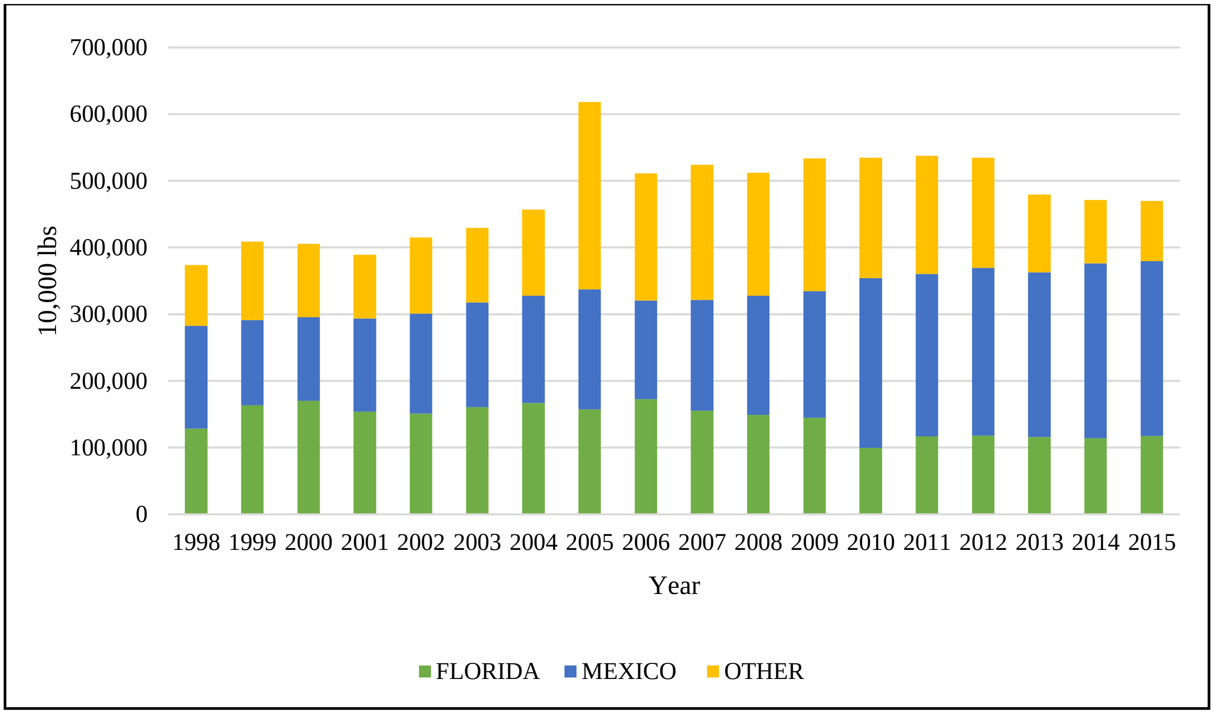


Figure 1.2.1 Tomato (round and plum) volume shipped in the U.S Market (Source: USDA – AMS)

1.3 Mexican Tomato Industry

Mexico is the primary source of U.S. tomato imports (USDA- ERS, 2016) and in 2003 Mexico exported 46 percent of its fresh tomatoes and 90 percent of those exports were directed to the United States (Cook and Calvin, 2005).

Mexican tomatoes are found in all Mexican States, however, historically, northwest Mexico, specifically the states of Sinaloa and Sonora, have been the main tomato growing region for exports to the United States during the winter months and the State of Baja California Norte during the summer; Figure 1.3.1 shows Mexico’s percentage of national tomato production by state and the main producer of tomatoes is the state of Sinaloa followed by Baja California, San Luis Potosi and Michoacan.

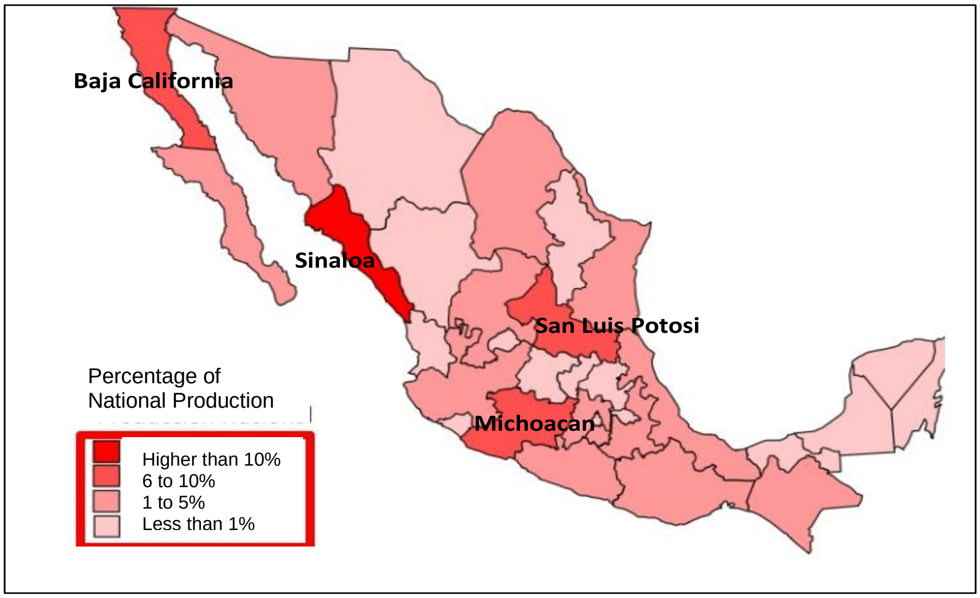


Figure 1.3.1 Mexican States national participation on tomato production (Source: Mexican Agriculture Department – SAGARPA)

In recent years tomato cultivation areas for export to the United States have expanded to other regions of Mexico, increasing export volumes and extending seasons. This expansion can be explained by the growing greenhouse production of tomatoes in Mexico; compared to conventional growing methods, greenhouse techniques increase yield and decrease production risk (Asci, et al., 2013).

According to the Mexican Protected Horticulture Association (AMHPAC), production under greenhouse in Mexico had increased to more than 57,000 acres in 2015 from 1,951 acres in 2000. Seventy percent of the greenhouse production in Mexico in 2015 was tomatoes and 80 percent of all greenhouse production was destined to the United States. Mexico has more greenhouse tomato area than either the United States or Canada (Cook and Calvin, 2005).

The highest number of greenhouses are in the northeast of Mexico with more than 13,000 acres, followed by western Mexico with over 4,800 acres (AMHPAC, 2015); the expansion of tomato growing areas is reflected in the increase of tomato volume imports through southern Texas ports of entry. Figure 1.3.2 shows how exports of Mexican tomatoes to the United States have increased through Texas and other ports of entry.

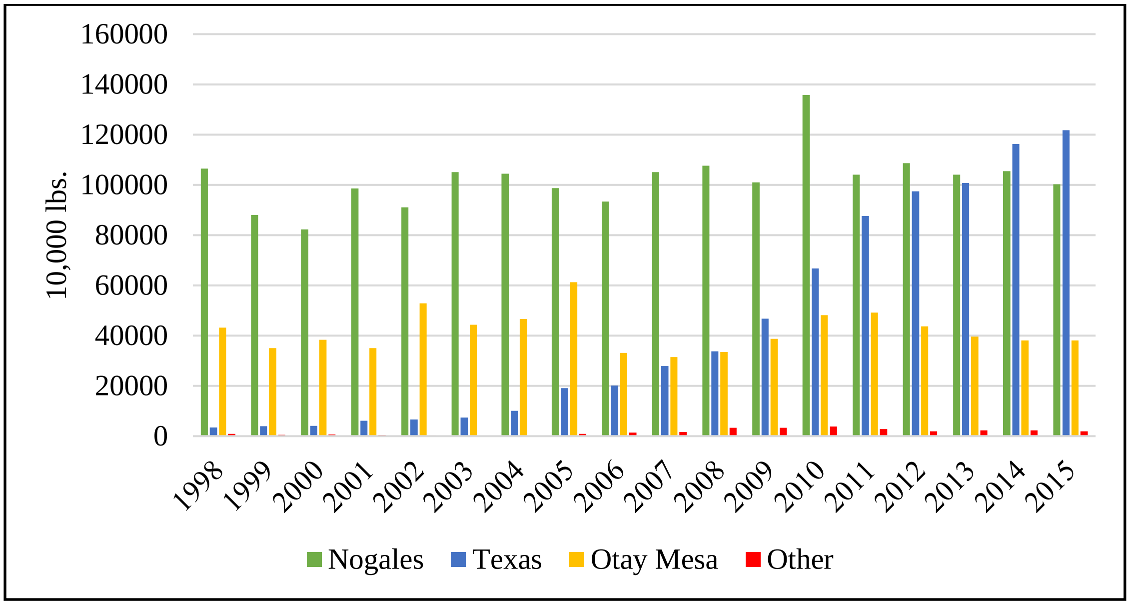


Figure 1.3.2 Share of Mexican Tomatoes Exported to the United States by Port of Entry (Source: USDA- AMS)

The increased importation of tomatoes from Mexico is not likely to diminish as it is estimated that U.S. produce imports from Mexico through land ports will increase 32 percent from 2012 to 2020, and most of the growth will occur through Texas ports of entry, with imports expected to grow 62 percent (Palma, et al., 2013).

1.4 Florida Tomato Industry

Tomatoes are the number one value crop for Florida (USDA-NASS 2016) and the state has been first in the United States in producing fresh-market tomatoes for decades (USDA-ERS, 2016), supplying tomatoes largely for winter months.

According to the Florida Tomato Committee[5], Florida's tomato industry is believed to have started in 1870s, with the major farms to grow tomatoes for the U.S. market in Manatee County

[5] http://www.floridatomatoes.org/tomato-101/

in west-central Florida; by 2013 Florida's tomato production was estimated to be one billion pounds. Florida's main tomato production areas comprise the counties of Pinellas, Hillsborough, Polk, Osceola, Brevard, and all counties situated to their south[6] (see Figure 1.4.1 for map of Florida production areas).

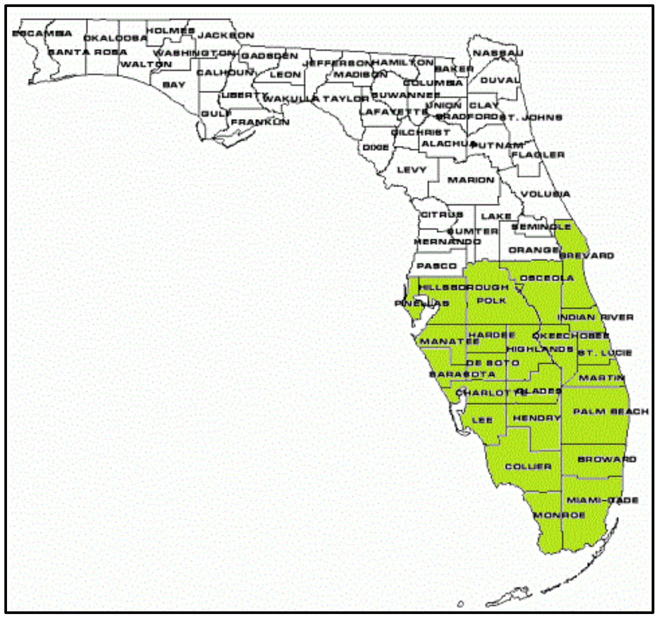


Figure 1.4.1 Tomato growing regions of Florida (Source: Author)

Tomatoes grown in Florida are harvested from October to June, with the most active harvesting months being November to May (USDA – NASS 2016). In 2016 Florida produced fresh-market tomatoes on 30,000 to 40,000 acres, about one-third of total U.S. fresh-tomato acreage, a share that has barely changed since the 1960s (USDA-ERS 2016).

According to the National Agricultural Statistics Service (USDA 2016), in 2015 Florida planted acreage for tomatoes decreased two percent compared to the previous year. The lack of increased fresh-tomato acreage has impacted the availability of tomatoes from Florida; additionally, Florida tomato production is grown on open field raised beds (USDA-NIFA 2006), which exposes the crop to weather events. Figure 1.4.2 shows the decrease of tomato shipments coming out of the State of Florida, in 2010 there is a sharp decrease of tomato shipments from Florida

[6] Florida Tomato Committee

due to abundant rains and sub-freezing temperatures during the first months of the year (Florida Department of Agriculture and Consumer Services 2011).

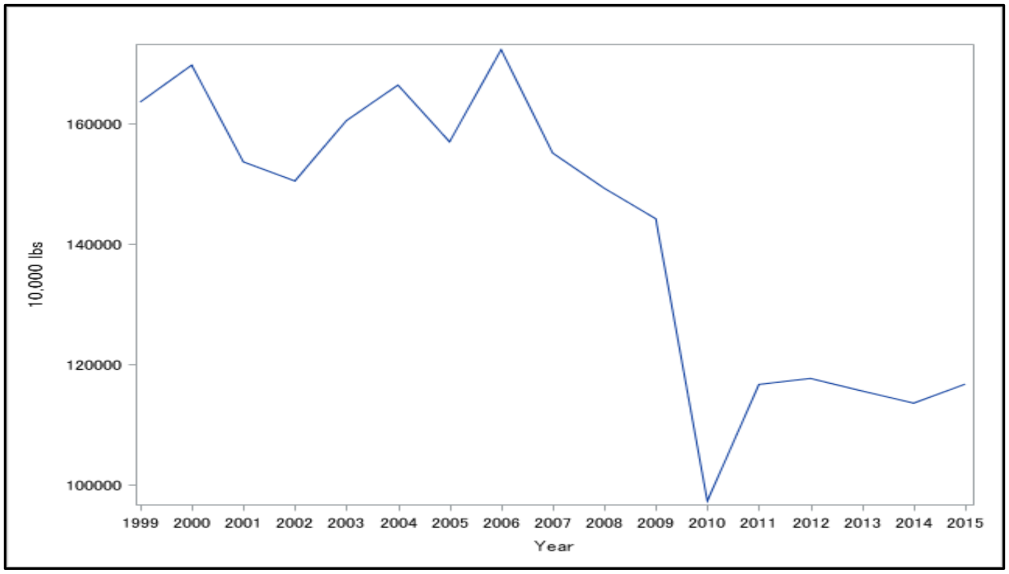


Figure 1.4.2 Total Tomatoes from Florida in the U.S. Market, 1999 to 2015 (Source: USDA-AMS)

Florida producers have traditionally benefited from the high prices during the winter tomato market because they produce tomatoes in the off-season of the United States; however, competition with Mexican producers has affected their profits (Asci, et al., 2013). Additionally, mature green tomatoes, the main tomato grown in Florida, have seen increased competition from greenhouse production of tomatoes which are preferred by consumers (Cook and Calvin, 2005).

Chapter 2: Literature Review

2.1 Literature Review

Ward (1982) studied the linkage and price transmission of retail, wholesale, and shipping point prices and found that wholesale price increase is not immediately passed back to shipping point to the same degree as when prices decrease, noticing generally a lag between wholesale price changes and shipping point price changes for fresh vegetables.

Ames et al. (1996) analyzed consumer welfare impact by setting tariffs on Mexican winter tomato imports as requested by Florida producers' 1996 petition. Their model included a demand for domestic tomato consumption equation, two supply equations, two retail price equations and an identity equation to bind the market segments together. Their model confirms that retail price movement follows wholesale price movement closely in the U.S. tomato market. It was also estimated that increasing tariffs on Mexican tomato imports would reduce the import price, but the volume would only decline about one percent.

Padilla-Bernal et al. (2000) estimated the impact of several economic and trade policy factors on the volume of fresh tomato imports from Mexico to the United States during the 1990s. The study developed a U.S.-Mexico tomato trade model, and took into consideration trading costs, volume of Mexican imports, exchange rate, tariffs, etc. The model used was a simultaneous equation system that included three behavioral equations, an identity to represent the excess U.S. demand for Mexican tomatoes, and a trading cost function. The results of this study supported their theory that much of the trade in the U.S. market is related to institutionalized trading relationships (commercial agreements) and that the quantity supplied of fresh tomatoes from Mexico to the U.S. market is insignificantly related to the entry market price of tomatoes and the exchange rate.

Padilla-Bernal et al. (2003) examined the relationship between major shipping points and terminal markets for Mexican imported, Florida and California tomatoes. They utilized the quasi-maximum-likelihood estimation for an extended parity bounds model for supply regions from

Mexican imports, California and Florida, on three representative terminal markets: Los Angeles, Chicago and Boston. However, they noted that only the western markets have received Mexican tomato shipments on a weekly basis and Chicago and Boston did not receive Mexican tomatoes year-round, possibly due to the distance from Mexican shipping points. The results showed that as distance between markets increases, the risk of doing business in those markets increases, probably due to time lags for shipping and the associated loss in quality. Consequently, the probability of having higher non-observable transaction cost or a longer adjustment period increases.

Thompson et al. (2005) analyzed the impact of the Tomato Suspension Agreement on imports of fresh tomatoes from Mexico; specifically, the impact of the floor price on Mexican tomato imports and supply-response for Florida fresh tomatoes. The study included the calculation of "growing degree days" to estimate the potential duration of harvest; a model for shipments of round tomatoes; a supply-response equation for Florida fresh tomatoes; and procedures for testing for distinct switching regimes/policies. The study found that price and quantity of fresh tomatoes from Florida are determined simultaneously; and it found evidence that there was a change in Florida supply-response of fresh tomatoes once the Tomato Suspension Agreement was in place, where Florida shipments were more responsive to own-price changes when prices of Mexican tomatoes were near the reference price of the Tomato Suspension Agreement.

Amizkuzuno et al. (2012) analyzed the impact of border and distance on price transmission between tomato markets in Ghana and Burkina-Faso. They selected four major fresh tomato consumer markets in Ghana and analyzed them when Burkina-Faso was the major source of tomatoes and when Ghana's fresh tomato supply was local. The analysis helped determine whether distance and international border matter for price transmission. It utilized two variants of a vector error correction model (VECM) focusing on prices and trade regimes, the standard and a regime-dependent one. The results show that producer and consumer markets do not drift apart in the long run; there is evidence of an interstate tomato market, where market prices adjust to achieve long-run market equilibrium. It was concluded that an increase in geographic distance and presence of international borders between markets appear to weaken, all other thing being equal, the speed of price transmission between producer market and consumer market.

This study takes into consideration the findings of the work previously mentioned, however it differentiates itself from these by tying together the analysis of terminal market prices of tomatoes based on volume and their shipping point prices, with the analysis of shipping point prices of tomatoes based on their volume and the restrictions of the Tomato Suspension Agreement (TSA), and with the analysis of volume of tomatoes based on the TSA restrictions, weather variables and seasonality. In addition this investigation gathers historical information about production areas, volumes and prices of fresh tomatoes at shipping points and terminal markets for 18 years (1998 to 2015). This analysis helps to have a broader understanding on the tomato market in the United States and the implications of the TSA for Mexican and Floridian tomatoes.

Chapter 3: Data and Methods

3.1 Objective of the Study

The objective of this study is to analyze different factors that influence the price of winter tomatoes[7] at terminal markets and shipping points. The study also looks at what drives tomato volumes up or down and analyzes the effect of the tomato suspension agreement on the volume of tomatoes in the United States market. Figure 3.1.1 shows the average volume of tomatoes from Mexico and Florida throughout the weeks of the year from 1998 to 2015.

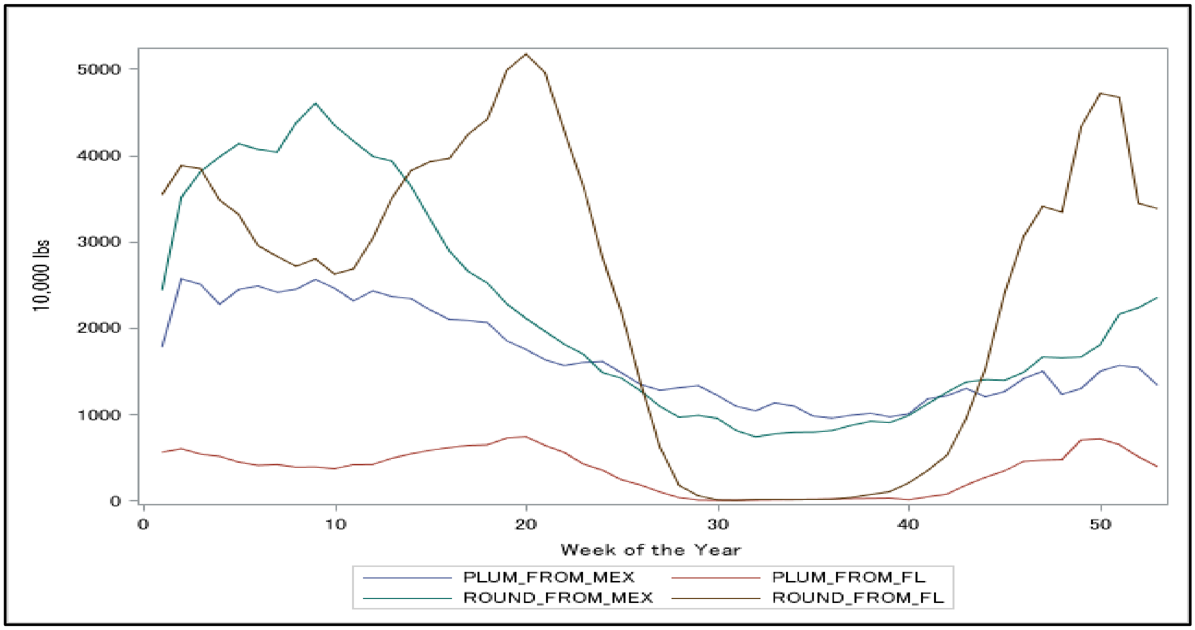


Figure 3.1.1: Average volume of Floridian and Mexican Tomatoes by their type and origin, 1998-2015 (Source: USDA-AMS)

Literature indicates that shipping-point prices for field grown tomatoes in the United States have frequently been under pressure because of imports and greenhouse products (USDA- ERS, 2016); therefore, this study also looks at volume in the United States market, especially that from imported tomatoes from Mexico, to see if there is a significant impact in the prices of tomatoes in the United States market. Figure 3.1.2 shows the average F.O.B. prices of round and plum/Roma tomatoes from 1998 to 2015.

[7] Mature green, vine ripe, and Roma or plum tomatoes are the scope of this study.

Figure 3.1.2 Yearly average of F.O.B. prices of tomatoes round and plum or Roma[8] from Florida and Mexico (Source: USDA-AMS)

Mexico has had a long trade relationship with the United States, and has provided tomatoes for many decades. The historical trade information allows comparisons of volume and prices during different weather conditions in Mexico and the United States to better understand possible factors that influence the tomato market in the United States.

The interest factors included in the study are volume of tomatoes in the United States, segregated by volume from Mexico, and Florida; shipping point prices of tomatoes from Florida and Mexico (Nogales, AZ, Otay Mesa, and Texas). Shipping cost based on the price of fuel during the same time periods, and weather-related factors in the main tomato growing regions of Florida and Mexico during the winter months.

For both tomatoes from Mexico and Florida in the Los Angeles, Chicago and New York terminal markets, respectively, it is expected to see a negative coefficient for volumes as the more product

[8] Roma tomatoes are synonymous of plum tomatoes.

is available the lower the prices would be. Shipping point prices and shipping cost are expected to have positive coefficients because of cost transmission.

Likewise for shipping point prices of tomatoes from Mexico and Florida, it is anticipated to see a negative coefficient for volumes. There is no prior expectation on the Tomato Suspension Agreement indicator (TSADUMMY) effect on shipping point prices; the coefficients could be either positive and show that when the TSA floor prices are binding Mexican tomatoes the marketers will push to quote higher prices, and the market will follow the rise in prices; or negative and show that the market will push prices down to pay the least possible price allowed.

For tomato volume results, a positive coefficient is expected for temperatures and a negative coefficient for squared temperature as warm weather helps tomato plants to start and increase production up to a certain temperature. Once this temperature is reached production of tomatoes will decrease. Precipitation is expected to have a negative coefficient given that rain can damage the quality of tomatoes. A negative TSADUMMY coefficient is expected for Mexican tomatoes if the floor prices are binding. However, it is possible to see a positive TSADUMMY coefficient for tomatoes from Florida if Florida producers seek an “opportunistic” behavior (Thompson et al. 2005). Seasonality is expected to be a significant factor for all tomatoes.

3.2 Data

All the data gathered for the analysis came from public domain sources. The information presented is weekly, and reflects seasonal floor prices from the Tomato Suspension Agreement, monthly changes in gasoline prices, as well as daily variations in temperature and precipitation.

Terminal market prices of tomatoes (round and plum), shipping point or free on board (F.O.B.) prices of tomatoes, and volume of tomatoes in the United States were accessed through the Agricultural Marketing Services, Market News portal (USDA). However, this information only goes back until the second week of January 1998, so due to this information limitation, the rest of the data gathered from other sources is narrowed to the same time period.

Other sources of information include the Bureau of Labor Statistics for Consumer Price Index, all urban consumers (CPI-U), which was utilized to deflate dollar values through time (1982-84=100); the United States Energy Information Administration for on-highway diesel fuel prices which were utilized to account for cost of shipping; the United States Department of Commerce – International Trade Administration, Enforcement and Compliance for Tomato Suspension Agreement floor prices; and the National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information for summaries of weather observations (air temperature and precipitation).

This study analyzes plum and round tomatoes only as these are the most important types of tomatoes sold in the United Sates. For example, in 2015, plum and round tomatoes accounted for 91 percent of all tomatoes sold in the U.S., while grape and cherry tomatoes accounted for about 9 percent (Figure 3.2.1).

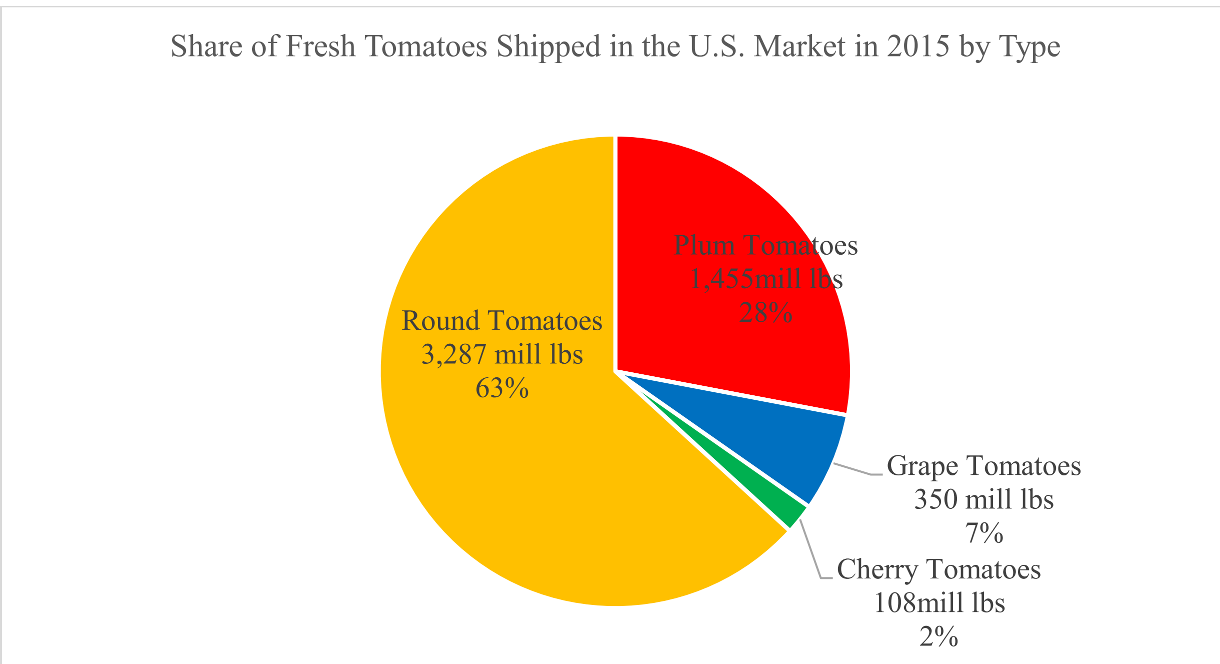


Figure 3.2.1: Share of Fresh Tomato Types Shipped in the U.S. Market in 2015 – all origins (Source: USDA-AMS)

Tomato prices utilized in the study to estimate wholesale prices are averages of the low price quotes of one pound of round and plum tomatoes. All prices represent the average price of their respective week regardless of size, color, packaging, or growing method.

Three terminal markets in the U.S. were chosen: New York Terminal Market on the East Coast, Los Angeles Terminal Market on the West Coast and Chicago Terminal Market in the Midwest.

After reviewing the seasonality of the Mexican and Floridian tomatoes during the 18 years of data collected, it was decided to utilize the information of the dates with highest volume and the dates with the most quotes of prices on terminal markets; see figures 3.2.2 and 3.2.3 which show the average volume of round and plum tomatoes respectively through the weeks of the year, the blue sections on these figures show the highest volumes for tomatoes of Mexico and Florida; figures 3.2.4, 3.2.5 and 3.2.6 show the aggregated prices of tomatoes at Chicago, Los Angeles, and New York terminal markets, respectively, for tomato price quotes from 1998 to 2015; matching the dates of the highest prices of the tomato suspension agreement (October 23 to June 30), shown by the blue areas in figures 3.2.2, 3.2.3, 3.2.4, 3.2.5, and 3.2.6.

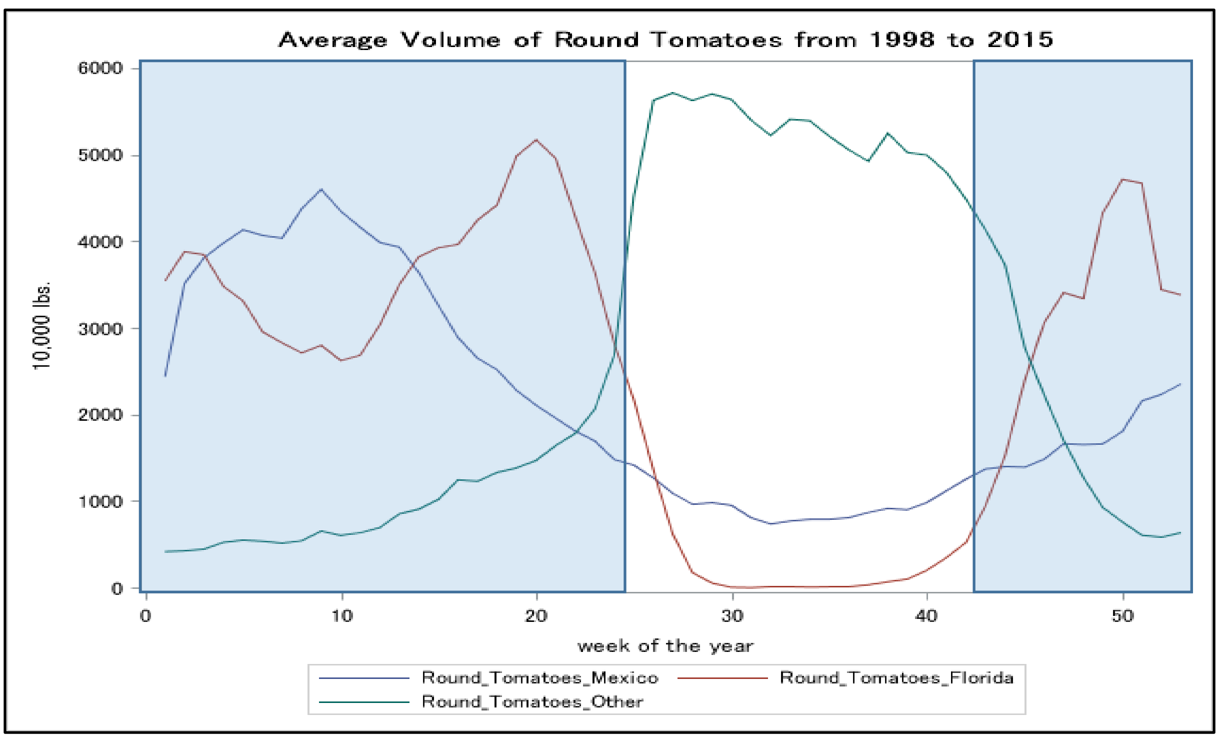


Figure 3.2.2: Average Round Tomato Volume from Various Sources for 1998 to 2015 (Source: USDA AMS)

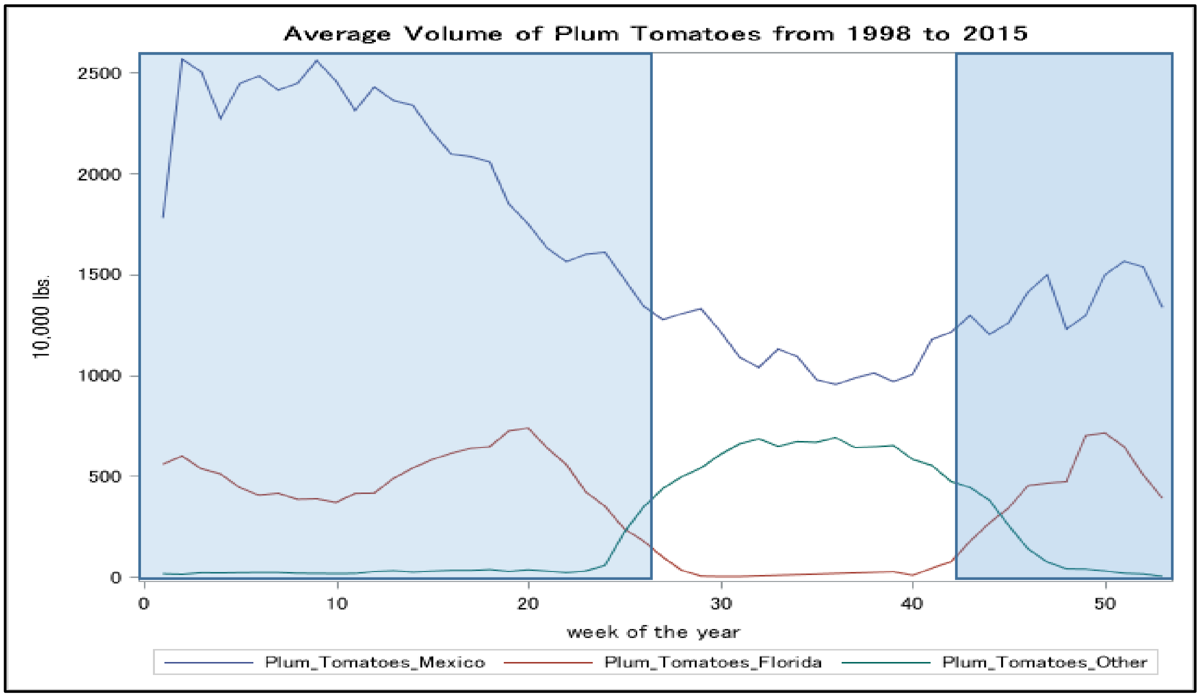


Figure 3.2.3: Average Plum Tomatoes Volume from Various Sources for 1998 to 2015 (Source: USDA-AMS)

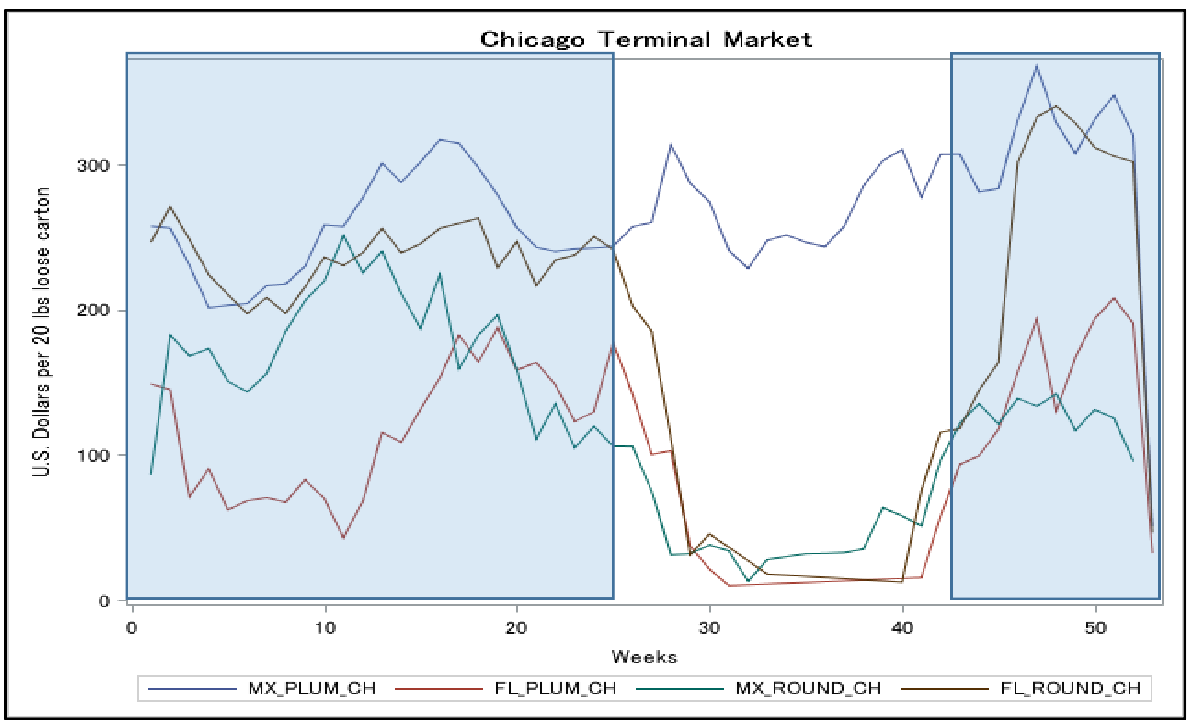


Figure 3.2.4: Aggregated Average Weekly Prices of Fresh Tomatoes in Chicago Terminal Market: By Source and Type of Tomato (Source: USDA-AMS)

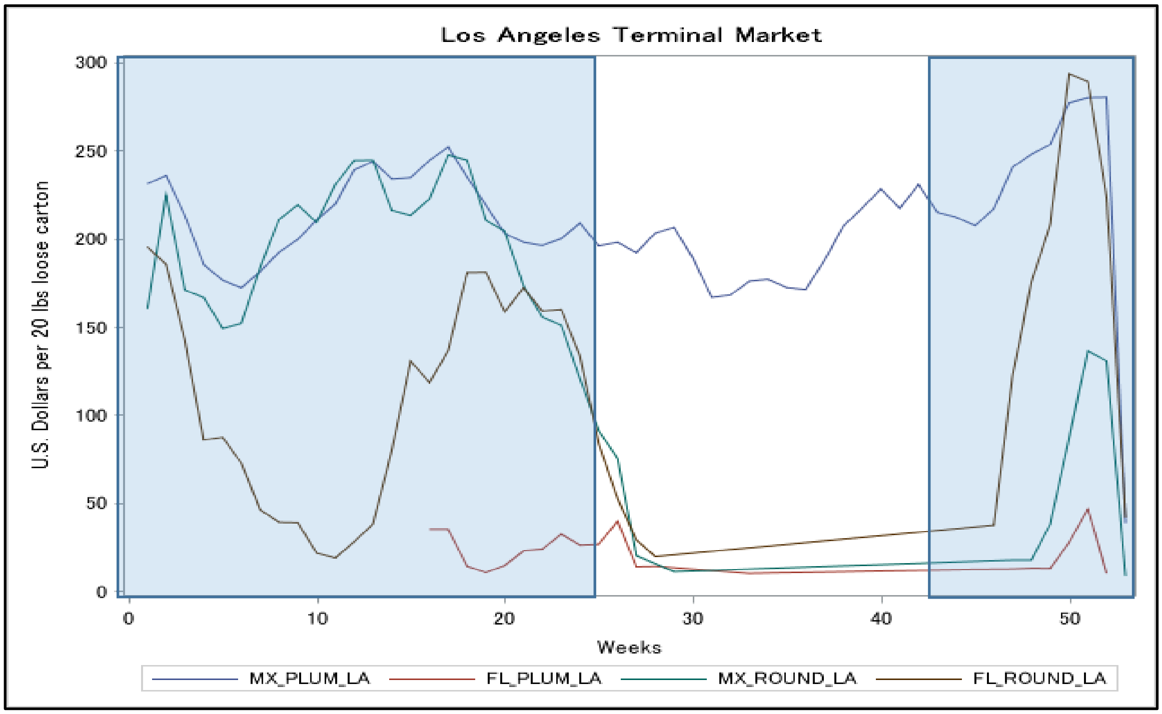


Figure 3.2.5: Aggregated Average Weekly Prices of Fresh Tomatoes in Los Angeles Terminal Market: By Source and Type of Tomato (Source: USDA-AMS)

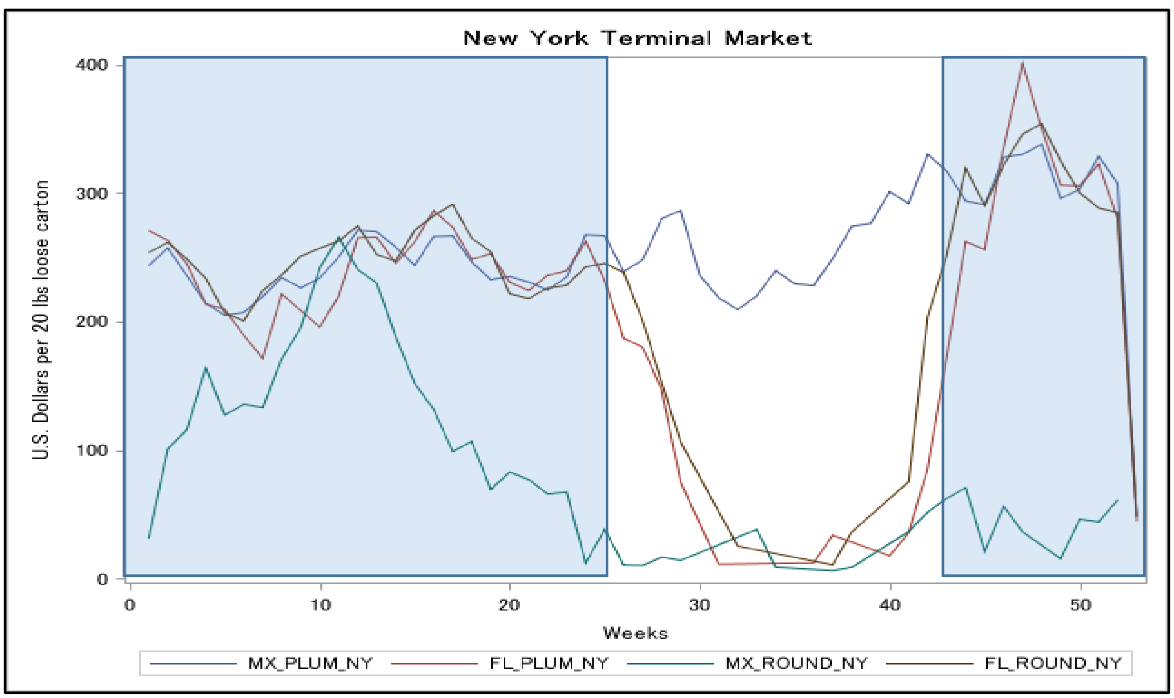


Figure 3.2.6: Aggregated Average Weekly Prices of Fresh Tomatoes in New York Terminal Market: By Source and Type of Tomato (Source: USDA-AMS)

3.3 Descriptive Statistics

All the estimations utilized weekly data of winter months (week 1 to 26, and week 44 to 53) from 1998 to 2015.

To facilitate calculations, all the variables that represent dollar values have been deflated by the CPI (1982-84=100), and this is reflected in their values.

To analyze terminal market prices, 22 variables were considered with a maximum of 631 observations each. The variables include time measurements, average low prices of tomatoes at terminal markets, average low prices at shipping point (F.O.B.), fuel price of diesel on highway, and the aggregated volume of tomatoes by region; table 3.3.1 shows each of these variables.

For the shipping point prices analysis 13 variables were considered with a maximum of 631 observations each; these include time measurements, average low prices at shipping point (F.O.B.), aggregated volume of tomatoes by region, volume of tomatoes by variety and region, and indicator of the Tomato Suspension Agreement floor price. Table 3.3.2 shows each of the variables utilized for shipping point prices analysis.

For the volume analysis 12 variables were considered, with a maximum of 631 observations each. The variables include, time measurements, volumes of tomatoes by variety and region, Maximum air temperature and precipitation by region weather stations, a week index, and an indicator of the Tomato Suspension Agreement floor price; table 3.3.3 shows each of these variables.

Tables 3.3.1, 3.3.2, and 3.3.3 show the variables description, the number of observations “N”, their sample mean, standard deviation, and minimum and maximum values.

Table 3.3.1 Descriptive Statistics Utilized for Terminal Market Prices, using data from winter months (October 23 to June 30) from 1998 to 2015

Variable	**Description**	**N**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
WEEK	Week of the observation	631	22.545	16.57	1	53
TOM_CHM	Weekly average price of one lb. of round tomatoes from Mexico at Chicago Terminal	618	0.004	0.001	0.002	0.012
TOM_CHF	Weekly average price of one lb. of round tomatoes from Florida at Chicago Terminal Market	610	0.004	0.002	0.001	0.014
TOM_LAM	Weekly average price of one lb. of round tomatoes from Mexico at Los Angeles Terminal Market	612	0.003	0.001	0.001	0.010
TOM_LAF	Weekly average price of one lb. of round tomatoes from Florida at Los Angeles Terminal Market	318	0.002	0.001	0.001	0.006
TOM_NYM	Weekly average price of one lb. of round tomatoes from	580	0.004	0.002	0.001	0.013

	Mexico at New York Terminal Market					
TOM_NYF	Weekly average price of one lb. of round tomatoes from Florida at New York Terminal Market	627	0.004	0.002	0.001	0.019
ROM_CHM	Weekly average price of one lb. of plum tomatoes from Mexico at Chicago Terminal Market	615	0.003	0.001	0.001	0.010
ROM_CHF	Weekly average price of one lb. of plum tomatoes from Florida at Chicago Terminal Market	318	0.003	0.001	0.001	0.011
ROM_LAM	Weekly average price of one lb. of plum tomatoes from Mexico at Los Angeles Terminal Market	610	0.002	0.001	0.001	0.007
ROM_LAF	Weekly average price of one lb. of plum tomatoes from Florida at Los Angeles Terminal Market	29	0.002	0.001	0.001	0.006
ROM_NYM	Weekly average price of one lb. of	619	0.003	0.001	0.001	0.011

	plum tomatoes from Mexico at New York Terminal Market					
ROM_NYF	Weekly average price of one lb. of plum tomatoes from Florida at New York Terminal Market	598	0.003	0.001	0.001	0.012
RFOBFL	Weekly average price f.o.b. of one lb. of plum tomatoes from Florida districts	597	0.002	0.001	0.001	0.008
RFOBMX	Weekly average price f.o.b. of one lb. of plum tomatoes from Mexico	571	0.002	0.001	0.001	0.008
TFOBFL	Weekly average price f.o.b. of one lb. of round tomatoes from Florida	628	0.002	0.001	0.001	0.008
TFOBMX	Weekly average of price f.o.b. one lb. of round tomatoes from Mexico	545	0.002	0.001	0.001	0.010
GAS	Weekly fuel price of diesel on highway, in dollars per gallon	631	0.012	0.004	0.006	0.021
VOLMX	Weekly aggregated volume of Mexican tomatoes in 1 million lbs.	631	44.408	19.658	9.74	100.77

VOLFL	Weekly aggregated volume of Floridian tomatoes in 1 million lbs.	631	39.582	15.540	2.61	94.75
TSADUMMY_T	Boolean indicator equivalent to 1 when f.o.b. prices of Mexican Round tomatoes is equal or less than the TSA values in a week	545	0.009	0.095	0	1
TSADUMMY_R	Boolean indicator equivalent to 1 when f.o.b. prices of Mexican plum tomatoes is equal or less than the TSA values in a week	571	0.194	0.396	0	1

Table 3.3.2 Descriptive Statistics Utilized for Point of Origin Prices, using data from winter months (October 23 to June 30) from 1998 to 2015

Variable	**Description**	**N**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
WEEK	Week of the observation	631	22.545	16.570	1	53
VOL_RMX	Weekly volume of plum tomatoes from Mexico in 1 million lb. units	631	17.034	9.649	0	48.61
VOL_RFL	Weekly volume of plum tomatoes from Florida in 1 million lb. units	631	4.754	2.521	0	14.39
VOL_TMX	Weekly volume of round tomatoes from Mexico in 1 million lb. units	631	27.374	13.385	4.91	74.98
VOL_TFL	Weekly volume of round tomatoes from Florida in 1 million lb. units	631	34.828	13.868	2.13	87.96
RFOBFL	Weekly f.o.b. average minimum price of 1 lb. of plum tomatoes from Florida	597	0.002	0.001	0.001	0.008
RFOBMX	Weekly f.o.b. average minimum price of 1 lb. of plum tomatoes from Mexico	571	0.002	0.001	0.001	0.008

TFOBFL	Weekly f.o.b. average minimum price of 1 lb. of round tomatoes from Florida	628	0.002	0.001	0.001	0.008
TFOBMX	Weekly f.o.b. average minimum price of 1 lb. of round tomatoes from Mexico	545	0.002	0.001	0.001	0.011
VOLMX	Weekly aggregated volume of Mexican tomatoes in 1 million lbs.	631	44.408	19.658	9.74	100.77
VOLFL	Weekly aggregated volume of Floridian tomatoes in 1 million lbs.	631	39.582	15.540	2.61	94.75
TSADUMMY_T	Boolean indicator equivalent to 1 when f.o.b. prices of Mexican Round tomatoes are equal or less than the TSA values in a week	545	0.009	0.095	0	1
TSADUMMY_R	Boolean indicator equivalent to 1 when f.o.b. prices of Mexican plum tomatoes are equal or less than the TSA values in a week	571	0.194	0.396	0	1

Table 3.3.3 Descriptive Statistics Utilized for Volume, using data from winter months (October 23 to June 30) from 1998 to 2015

Variable	**Description**	**N**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
WEEK	Week of the observation	631	22.545	16.570	1	53
VOL_RMX	Weekly volume of plum tomatoes from Mexico in 1 million lb. units	631	17.034	9.649	0	48.61
VOL_RFL	Weekly volume of plum tomatoes from Florida in 1million lb. units	631	4.754	2.521	0	14.39
VOL_TMX	Weekly volume of round tomatoes from Mexico in 1 million lb. units	631	27.374	13.385	4.91	74.98
VOL_TFL	Weekly volume of round tomatoes from Florida in 1 million lb. units	597	0.002	0.001	0.001	0.008
MEYERTMAX	Weekly average maximum air temperature in ˚F at Ft. Meyer weather station	623	81.972	6.777	57.428	96
MEYERPRCP	Weekly aggregated precipitation measured in inches	623	0.634	1.081	0	8.47

	at Ft. Meyer weather station					
CULTMAX	Weekly average maximum air temperature in ˚F at Culiacan weather station	493	90.259	5.674	72.5	107
CULPRCP	Weekly aggregated precipitation measured in inches at Culiacan weather station	544	0.049	0.432	0	8.73
TSADUMMY_T	Boolean indicator equivalent to 1 when f.o.b. prices of Mexican round tomatoes are equal or less than the TSA values in a week	545	0.009	0.095	0	1
TSADUMMY_R	Boolean indicator equivalent to 1 when f.o.b. prices of Mexican plum tomatoes are equal or less than the TSA values in a week	571	0.194	0.396	0	1
IWEEK	Index of the week during the year; where IWEEK = week/ 53	631	0.425381	0.312635	0.018868	1

3.4 Empirical Models

Models used for analyzing terminal market prices, point of origin prices and tomato shipments volumes are presented in this section.

3.4.1 Terminal Market Price Model

The terminal market prices for plum tomatoes are specified as:

(1) $\mathrm{ROM}_{\mathrm{CHM}_{\mathrm{w}}} = \beta 1_1 + \beta 2_1\ \mathrm{VOLMX}_{w-1} + \beta 3_1\ \mathrm{VOLFL}_{w-1} + \beta 4_1\ \mathrm{RFOBMX}_{w-1} + \beta 5_1\ GAS_{w-1} + \varepsilon_w$

(2) $\mathrm{ROM\_CHF}_{w} = \beta 1_2 + \beta 2_2\ \mathrm{VOLMX}_{w-1} + \beta 3_2\ \mathrm{VOLFL}_{w-1} + \beta 4_2\ \mathrm{RFOBFL}_{w-1} + \beta 5_2\ GAS_{w-1} + \varepsilon_w$

(3) $\mathrm{ROM\_LAM}_{\mathrm{w}} = \beta 1_3 + \beta 2_3\ \mathrm{VOLMX}_{w-1} + \beta 3_3\ \mathrm{VOLFL}_{w-1} + \beta 4_3\ \mathrm{RFOBMX}_{w-1} + \beta 5_3\ GAS_{w-1} + \varepsilon_w$

(4) $\mathrm{ROM\_LAF}_{w} = \beta 1_4 + \beta 2_4\ \mathrm{VOLMX}_{w-1} + \beta 3_4\ \mathrm{VOLFL}_{w-1} + \beta 4_4\ \mathrm{RFOBFL}_{w-1} + \beta 5_4\ GAS_{w-1} + \varepsilon_w$

(5) $\mathrm{ROM\_NYM}_{\mathrm{w}} = \beta 1_5 + \beta 2_5\ \mathrm{VOLMX}_{w-1} + \beta 3_5\ \mathrm{VOLFL}_{w-1} + \beta 4_5\ \mathrm{RFOBMX}_{w-1} + \beta 5_5\ GAS_{w-1} + \varepsilon_w$

(6) $\mathrm{ROM\_NYF}_{w} = \beta 1_6 + \beta 2_6\ \mathrm{VOLMX}_{w-1} + \beta 3_6\ \mathrm{VOLFL}_{w-1} + \beta 4_6\ \mathrm{RFOBFL}_{w-1} + \beta 5_6\ GAS_{w-1} + \varepsilon_w$

Where, w represents week. Definitions of the variables are given in table 3.3.1.
All of the explanatory variables, are lagged, as it was assumed a lag between shipping point prices (Ward, 1982), volume and the terminal markets prices. A total of six terminal market equations [(1) to (6)] for plum tomatoes are estimated.

The terminal market prices for round tomatoes are similarly specified as:

(7) $\mathrm{TOM\_CHM}_{\mathrm{w}} = \beta 1_7 + \beta 2_7\ \mathrm{VOLMX}_{w-1} + \beta 3_7\ \mathrm{VOLFL}_{w-1} + \beta 4_7\ \mathrm{TFOBMX}_{w-1} + \beta 5_7\ GAS_{w-1} + \varepsilon_w$

(8) $\mathrm{TOM\_CHF}_{w} = \beta 1_8 + \beta 2_8\ \mathrm{VOLMX}_{w-1} + \beta 3_8\ \mathrm{VOLFL}_{w-1} + \beta 4_8\ \mathrm{TFOBFL}_{w-1} + \beta 5_8\ GAS_{w-1} + \varepsilon_w$

(9) $\mathrm{TOM\_LAM_w} = \beta 1_9 + \beta 2_9\ \mathrm{VOLMX}_{w-1} + \beta 3_9\ \mathrm{VOLFL}_{w-1} + \beta 4_9\ \mathrm{TFOBMX}_{w-1} + \beta 5_9\ GAS_{w-1} + \varepsilon_w$

(10) $\mathrm{TOM\_LAF}_w = \beta 1_{10} + \beta 2_{10}\ \mathrm{VOLMX}_{w-1} + \beta 3_{10}\ \mathrm{VOLFL}_{w-1} + \beta 4_{10}\ \mathrm{TFOBFL}_{w-1} + \beta 5_{10}\ GAS_{w-1} + \varepsilon_w$

(11) $\mathrm{TOM\_NYM_w} = \beta 1_{11} + \beta 2_{11}\ \mathrm{VOLMX}_{w-1} + \beta 3_{11}\ \mathrm{VOLFL}_{w-1} + \beta 4_{11}\ \mathrm{TFOBMX}_{w-1} + \beta 5_{11}\ GAS_{w-1} + \varepsilon_w$

(12) $\mathrm{TOM\_NYF}_w = \beta 1_{12} + \beta 2_{12}\ \mathrm{VOLMX}_{w-1} + \beta 3_{12}\ \mathrm{VOLFL}_{w-1} + \beta 4_{12}\ \mathrm{TFOBFL}_{w-1} + \beta 5_{12}\ GAS_{w-1} + \varepsilon_w$

Definitions of the variables are explained in table 3.3.2. Similarly to terminal market equations for plum tomatoes all of the explanatory variables are lagged. A total of six terminal market equations [(7) to (12)] for round tomatoes are estimated.

3.4.2 Shipping Point Price Model

To estimate shipping point prices the utilization of consolidated tomato volumes from Mexico and Florida were investigated; yet it was considered important to explain the effects of the volume of each tomato type on shipping point prices.

The shipping point prices for plum and round tomatoes from Mexico and Florida with consolidated volume are specified as follows:

(13) $RFOBMX_w = \beta 1_{13} + \beta 2_{13}\ VOLMX_{w-1} + \beta 3_{13}\ VOLFL_{w-1} + \beta 4_{13}\ TSADUMMY_{w-1} + \varepsilon_w$

(14) $RFOBFL_w = \beta 1_{14} + \beta 2_{14}\ VOLMX_{w-1} + \beta 3_{14}\ VOLFL_{w-1} + \beta 4_{14}\ TSADUMMY_{w-1} + \varepsilon_w$

(15) $TFOBMX_w = \beta 1_{15} + \beta 2_{15}\ VOLMX_{w-1} + \beta 3_{15}\ VOLFL_{w-1} + \beta 4_{15}\ TSADUMMY_{w-1} + \varepsilon_w$

(16) $TFOBFL_w = \beta 1_{16} + \beta 2_{16}\ VOLMX_{w-1} + \beta 3_{16}\ VOLFL_{w-1} + \beta 4_{16}\ TSADUMMY_{w-1} + \varepsilon_w$

An alternate specification for modeling shipping point prices is tried where individual volumes of tomatoes by type rather than combined is used. And the shipping point prices for plum and round tomatoes from Mexico and Florida with segregated volumes by type of tomatoes are specified as follows:

(17) $RFOBMX_w = \beta 1_{17} + \beta 2_{17}\, VOL\_TMX_{w-1} + \beta 3_{17}\, VOL\_TFL_{w-1} + \beta 4_{17}\, VOL\_RMX_{w-1} + \beta 5_{17}\, VOL\_RFL_{w-1} + \beta 6_{17}\, TSADUMMY_{w-1} + \varepsilon_w$

(18) $RFOBFL_w = \beta 1_{18} + \beta 2_{18}\, VOL\_TMX_{w-1} + \beta 3_{18}\, VOL\_TFL_{w-1} + \beta 4_{18}\, VOL\_RMX_{w-1} + \beta 5_{18}\, VOL\_RFL_{w-1} + \beta 6_{18}\, TSADUMMY_{w-1} + \varepsilon_w$

(19) $TFOBMX_w = \beta 1_{19} + \beta 2_{19}\, VOL\_TMX_{w-1} + \beta 3_{19}\, VOL\_TFL_{w-1} + \beta 4_{19}\, VOL\_RMX_{w-1} + \beta 5_{19}\, VOL\_RFL_{w-1} + \beta 6_{19}\, TSADUMMY_{w-1} + \varepsilon_w$

(20) $TFOBFL_w = \beta 1_{20} + \beta 2_{20}\, VOL\_TMX_{w-1} + \beta 3_{20}\, VOL\_TFL_{w-1} + \beta 4_{20}\, VOL\_RMX_{w-1} + \beta 5_{20}\, VOL\_RFL_{w-1} + \beta 6_{20}\, TSADUMMY_{w-1} + \varepsilon_w$

Definition of the variables are explained in table 3.2.1. A total of eight shipping point price equations are estimated, equations [(13) to (20)]. Utilizing the same considerations as for terminal market price equations, all of the explanatory variables for shipping point prices are lagged.

3.4.3 Volume Model

The volume equations utilize weather-related factors in their estimation. The utilization of growing degree days (Thompson, et al., 2005) was considered to project the duration of harvest from Florida and Mexico. The growing degree days are estimated by the accumulation of the daily average temperature minus the chilling injury minimum temperature (LeStrange et al., 2000)[9]. However, the results of these estimations were not conclusive (estimates were not significant) and it was decided to utilize the maximum temperature and the squared maximum temperature to estimate the volume of fresh tomatoes.

[9] Tomato plants undergo chilling injury when night temperatures fall below 50˚F

The volume of round and plum tomatoes from Mexico and Florida are specified as follows:

(21) $VOL\_RMX_w = \beta 1_{21} + \beta 2_{21}\, CULTMAX_{w-1} + \beta 3_{21}\, CULTMAX_{w-1}^2 + \beta 4_{21}\, CULPRCP_{w-1} + \beta 5_{21}\, TSADUMMY_{w-1} + \alpha 1_{21}\, IWEEK + \alpha 2_{21}\, IWEEK^2 + \alpha 3_{21}\, IWEEK^3 + \alpha 4_{21}\, IWEEK^4 + \varepsilon_w$

(22) $VOL\_TMX_w = \beta 1_{22} + \beta 2_{22}\, CULTMAX_{w-1} + \beta 3_{22}\, CULTMAX_{w-1}^2 + \beta 4_{22}\, CULPRCP_{w-1} + \beta 5_{22}\, TSADUMMY_{w-1} + \alpha 1_{22}\, IWEEK + \alpha 2_{22}\, IWEEK^2 + \alpha 3_{22}\, IWEEK^3 + \alpha 4_{22}\, IWEEK^4 + \varepsilon_w$

(23) $VOL\_RFL_w = \beta 1_{23} + \beta 2_{23}\, MAYERTMAX_{w-1} + \beta 3_{23}\, MAYERTMAX_{w-1}^2 + \beta 4_{23}\, MAYERPRCP_{w-1} + \beta 5_{23}\, TSADUMMY_{w-1} + \alpha 1_{23}\, IWEEK + \alpha 2_{23}\, IWEEK^2 + \alpha 3_{23}\, IWEEK^3 + \alpha 4_{23}\, IWEEK^4 + \varepsilon_w$

(24) $VOL\_TFL_w = \beta 1_{24} + \beta 2_{24}\, MAYERTMAX_{w-1} + \beta 3_{24}\, MAYERTMAX_{w-1}^2 + \beta 4_{24}\, MAYERPRCP_{w-1} + \beta 5_{24}\, TSADUMMY_{w-1} + \alpha 1_{24}\, IWEEK + \alpha 2_{24}\, IWEEK^2 + \alpha 3_{24}\, IWEEK^3 + \alpha 4_{24}\, IWEEK^4 + \varepsilon_w$

The coefficient α4 us restricted as α4= –α1 –α2 –α3, to make sure that there are no jumps in seasonality as we transition from the last week of one year to the first week of the next year. Definitions of the variables are given in table 3.2.1. A total of four volume equations are estimated, equations [(21) to (24)].

All of the explanatory variables of the volume equations are lagged, with exeption of IWEEK. It is assumed that the events of a previous week would affect the volume sent to the market on the following week.

Chapter 4: Results

4.1 Results for Price of Terminal Market Equations

Results of terminal market prices of plum tomatoes from Mexico are shown in table 4.1.1. As expected, volume variables have negative influence on terminal market prices and are statistically significant except for tomatoes from Florida at Los Angeles terminal market; literature shows that tomatoes from Florida are generally commercialized in the U.S. east coast, which could explain the lack of statistical significance of these tomatoes at Los Angeles terminal market. Shipping point and gas prices parameters are positive and statistically significant (except for gas prices at Chicago terminal market), showing price transmission as expected.

Table 4.1.1: Least Square Estimates of Terminal Market Price Equations for Plum Tomatoes from Mexico

Terminal Market Price - Plum Tomatoes from Mexico						
Dependent Variable	Price of Tomatoes from Mexico at Chicago (ROM_CHM)		Price of Tomatoes from Mexico at Los Angeles (ROM_LAM)		Price of Tomatoes from Mexico at New York (ROM_NYM)	
Explanatory Variables	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**
Intercept	0.0014***	8.58	0.0009***	8.1	0.0011***	8.23
VOLMX_LAG	-0.000006***	-3.38	-0.000007***	-6.46	-0.000005***	-3.98
VOLFL_LAG	-0.000005***	-2.6	-0.000001	-1.14	-0.000006***	-4.17
RFOBMX_LAG	0.9989***	26.63	0.7916***	32.41	0.9964***	32.1
GAS	0.0073	1.05	0.0188***	4.08	0.0243***	4.17
R-Square	0.592		0.6925		0.6843	
Observations Used	562		568		561	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Terminal market price results for tomatoes from Florida are shown in table 4.1.2; it is important to mention that the results of plum tomatoes from Florida at Los Angeles terminal market are based on a sample of 29 observations limited by the number of times weekly prices of plum tomatoes from Florida were observed at this market from 1998 to 2015. Volume parameters are negative and statistically significant as expected, except for Florida tomatoes at Los Angeles terminal market, like the results for plum tomatoes from Mexico. Shipping point prices are positive and statistically significant as expected; gas prices are positive and only statistically significant at New York terminal market. For plum tomatoes from Florida only price transmission of its shipping point price is reflected on Chicago and Los Angeles terminal markets given that gas prices are not significant for these markets; only New York terminal market show price transmission for shipping point and gas prices.

Table 4.1.2: Least Square Estimates of Terminal Market Price Equations for Plum Tomatoes from Florida

Terminal Market Price - Plum Tomatoes from Florida						
Dependent Variable	Price of Tomatoes from Florida at Chicago (ROM_CHF)		Price of Tomatoes from Florida at Los Angeles (ROM_LAF)		Price of Tomatoes from Florida at New York (ROM_NYF)	
Explanatory Variables	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**
Intercept	0.04988***	8.18	0.0004	1.02	0.0013***	7.59
VOLMX_LAG	-0.00047***	-7.06	-0.000031*	-1.87	-0.000011***	-7.29
VOLFL_LAG	-0.00022***	-3.44	0.000003	0.51	-0.000008***	-4.05
RFOBFL_LAG	0.83416***	17.22	1.1472***	9.88	0.8194***	26.31
GAS	0.19738	0.93	0.0449	1.03	0.0290***	4.19
R-Square	0.616		0.8831		0.6337	
Observations Used	313		29		578	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Prices of terminal markets for plum tomatoes of both Mexico and Florida show, that generally, volumes from competing areas have a higher negative effect on terminal market prices than those of their own volume, i.e. the volume of tomatoes from Florida had a higher negative impact on prices of Mexican tomatoes and vice versa; with exception of Los Angeles terminal market, where prices of Floridian and Mexican tomatoes were the volume of tomatoes from Florida was not statistically significant (tables 4.1.1 and 4.1.2).

Results of terminal market prices of round tomatoes form Mexico are in table 4.1.3, where it is shown that volumes are not statistically significant for neither New York nor Chicago terminal markets. These results show that if there is an influence of the volume of tomatoes on prices this would have to be already reflected at the shipping point price. Volume at Los Angeles terminal market is negative as expected and statistically significant. All shipping point and gas prices for round tomatoes from Mexico are positive and statistically significant as expected for price transmission.

Round tomatoes from Florida terminal market prices results are shown in table 4.1.4. The parameter estimates of volume of Mexican tomatoes are not significant at the main markets of tomatoes from Florida, i.e. New York and Chicago; volume of tomatoes from Florida at Los Angeles terminal market is not statistically significant like the results of plum tomatoes from Florida and Mexico (table 4.1.1 and 4.1.2). Round tomatoes from Florida shipping point and gas prices are positive and statistically significant as expected; except for gas prices at New York terminal market which is not statistically significant; this result at this time cannot be explained.

Table 4.1.3: Least Square Estimates of Terminal Market Price Equations for Round Tomatoes from Mexico

Terminal Market Price - Round Tomatoes from Mexico						
Dependent Variable	Price of Tomatoes from Mexico at Chicago (TOM_CHM)		Price of Tomatoes from Mexico at Los Angeles (TOM_LAM)		Price of Tomatoes from Mexico at New York (TOM_NYM)	
Explanatory Variables	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**
Intercept	0.0019***	7.06	0.0009***	3.95	0.0019***	5.48
VOLMX_LAG	0.000002	0.66	-0.000013***	-6.05	-0.000002	-0.75
VOLFL_LAG	-0.000002	-0.073	-0.000011***	-4.54	0.000005	1.37
TFOBMX_LAG	0.8062***	21.02	0.7014***	21.82	0.8049***	17.2
GAS	0.0204*	1.86	0.1479***	16.21	0.0256*	1.9
R-Square	0.4615		0.5946		0.3824	
Observations Used	538		544		509	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4.1.4: Least Square Estimates of Terminal Market Price Equations for Round Tomatoes from Florida.

Terminal Market Price - Round Tomatoes from Florida						
Dependent Variable	Price of Tomatoes from Florida at Chicago (TOM_CHF)		Price of Tomatoes from Florida at Los Angeles (TOM_LAF)		Price of Tomatoes from Florida at New York (TOM_NYF)	
Explanatory Variables	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**	**Parameter Estimate**	**t Val.**
Intercept	0.0006	1.48	0.0008***	3.76	0.0014***	3.96
VOLMX_LAG	-0.000002	-0.56	-0.00001***	-5.91	0.0000003	0.1
VOLFL_LAG	-0.000014***	-9.98	-0.00000004	-0.16	-0.000008*	-1.92
TFOBFL_LAG	0.9095***	12.31	0.8044***	18.06	1.0666***	15.82
GAS	0.1641***	9.89	0.0451***	4.93	0.0220	1.38
R-Square	0.3877		0.5837		0.3634	
Observations Used	607		316		625	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

4.2. Results for Shipping Point Price Equations

Results for shipping point prices of both consolidated and segregated volume equations for Mexican plum tomatoes are in table 4.2.1; for Mexican round tomatoes in table 4.2.2; for plum tomatoes from Florida in table 4.2.3; and for round tomatoes from Florida in table 4.2.4.

Table 4.2.1: Least Square Estimates of Shipping Point Price Equations of Plum Tomatoes from Mexico

Dependent Variable	**Price of Plum Tomatoes from Mexico (RFOBMX)**			
	Consolidated Volume		**Segregated Volume**	
Explanatory Variables	**Parameter Estimate**	**t Value**	**Parameter Estimate**	**t Value**
Intercept	0.00253***	19.83	0.00261***	20.38
VOLMX_LAG	-0.000010***	-6.53		
VOLFL_LAG	-0.000009***	-4.72		
VOL_TMX_LAG			-0.00001***	-3.25
VOL_TFL_LAG			-0.000016***	-5.95
VOL_RMX_LAG			-0.000017***	-4.79
VOL_RFL_LAG			0.00005***	3.14
TSADUMMY_R_LAG	-0.00407***	-6.27	-0.00036***	-5.20
R-Square	0.148		0.1692	
Observations Used	559		559	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4.2.2: Least Square Estimates of Shipping Point Price Equations of Round Tomatoes from Mexico

Dependent Variable	**Price of Round Tomatoes from Mexico (TFOBMX)**			
	Consolidated Volume		**Segregated Volume**	
Explanatory Variables	**Parameter Estimate**	**t Value**	**Parameter Estimate**	**t Value**
Intercept	0.00394***	17.53	0.004***	17.52
VOLMX_LAG	-0.00002***	-7.61		
VOLFL_LAG	-0.00002***	-5.76		
VOL_TMX_LAG			-0.00002***	-5.64
VOL_TFL_LAG			-0.00002***	-4.59
VOL_RMX_LAG			-0.00002***	-3.09
VOL_RFL_LAG			0.00002	0.59
TSADUMMY_T_LAG	-0.00098**	-2.29	-0.00101**	-2.37
R-Square	0.1168		0.1231	
Observations Used	527		527	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4.2.3: Least Square Estimates of Shipping Point Price Equations of Plum Tomatoes from Florida

Dependent Variable	**Price of Plum Tomatoes from Florida (RFOBFL)**			
	Consolidated Volume Equation		**Segregated Volume Equation**	
Explanatory Variables	**Parameter Estimate**	**t Value**	**Parameter Estimate**	**t Value**
Intercept	0.00337***	22.00	0.00335***	21.82
VOLMX_LAG	-0.00001***	-5.59		
VOLFL_LAG	-0.00002***	-7.56		
VOL_TMX_LAG			-0.00001**	-2.44
VOL_TFL_LAG			-0.00002***	-4.71
VOL_RMX_LAG			-0.00002***	-4.03
VOL_RFL_LAG			-0.00003	-1.49
TSADUMMY_R_LAG	-0.00039***	-4.99	-0.00046***	-5.42
R-Square	0.1633		0.1702	
Observations Used	539		539	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4.2.4: Least Square Estimates of Shipping Point Price Equations of Round Tomatoes from Florida

Dependent Variable	**Price of Round Tomatoes from Florida (TFOBFL)**			
	Consolidated Volume Equation		**Segregated Volume Equation**	
Explanatory Variables	**Parameter Estimate**	**t Value**	**Parameter Estimate**	**t Value**
Intercept	0.00317***	18.29	0.00317***	18.13
VOLMX_LAG	0.000001	0.78		
VOLFL_LAG	-0.00003***	-11.56		
VOL_TMX_LAG			-0.000003	-1.02
VOL_TFL_LAG			-0.00003***	-7.32
VOL_RMX_LAG			0.00001*	1.90
VOL_RFL_LAG			-0.00003	-1.27
TSADUMMY_T_LAG	-0.00077**	-2.15	-0.00079**	-2.21
R-Square	0.2508		0.258	
Observations Used	543		543	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Results of volumes of both Mexico and Florida in all equations with consolidated volumes, [(13) to (16)], show negative and statistically significant parameter estimates as expected; except for volume of Mexican tomatoes on shipping point prices of round tomatoes from Florida, whose coefficient is positive and has no statistical significance. In addition, results of the segregated volume equation for round tomatoes from Florida, show that volume from round and plum tomatoes from Mexico are not statistically significant and positive signed respectively (table 4.2.4). These results suggest that Mexican tomatoes volume has no influence on the prices of round tomatoes from Florida.

The parameter estimates of plum tomatoes from Florida volume are not statistically significant for shipping point prices of Mexican round tomatoes, and Floridian round and plum tomatoes; Mexican plum tomatoes, however, show a positive sign and is statistically significant. A possible explanation for the lack of statistical significance in these results is the amount of plum tomatoes that Florida introduces to the U.S. market which in average is 3.3 million pounds per week (table 3.2.3) equivalent only to 12% of all the tomato volume from Florida. As for the statistically significance and positive sign on the results for plum tomatoes from Mexico, a possible theory is that the volume produced by Florida is not enough to cover the market demand (trading relationships), therefore creating demand for plum tomatoes from Mexico, in order to corroborate this theory further investigation needs to be done.

Parameter estimates of tomato volumes of plum and round tomatoes from Mexico, and round tomatoes from Florida for all segregated volume equations [(17) to (20)] are negative and statistically significant as previously expected (tables 4.2.1, 4.2.2, 4.2.3, and 4.2.4).

The results of the TSA indicator for all tomatoes of both Florida and Mexico in both consolidated and segregated volume equations [(13) to (20)] are negative and statistically significant. These results suggest that having a reference price affects negatively the prices of all tomatoes in the market independently of their origin. Figures 4.2.1 and 4.2.2 show a comparison of weekly prices of Mexico and Florida tomatoes and TSA reference price during the winter months of 1998 to 2015 where it can be seen similar behaviors of f.o.b. prices for the two regions.

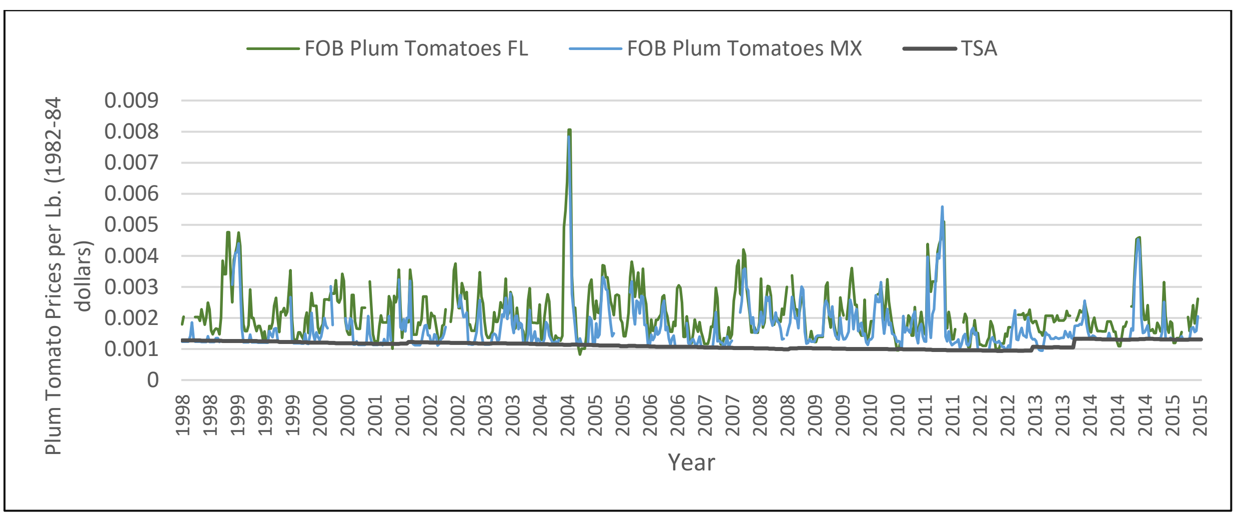


Figure 4.2.1: Comparison of Prices of Mexican and Floridian Plum Tomatoes and TSA Reference Price during winter months from 1998 to 2015. (Source: USDA-AMS and Department of Commerce)

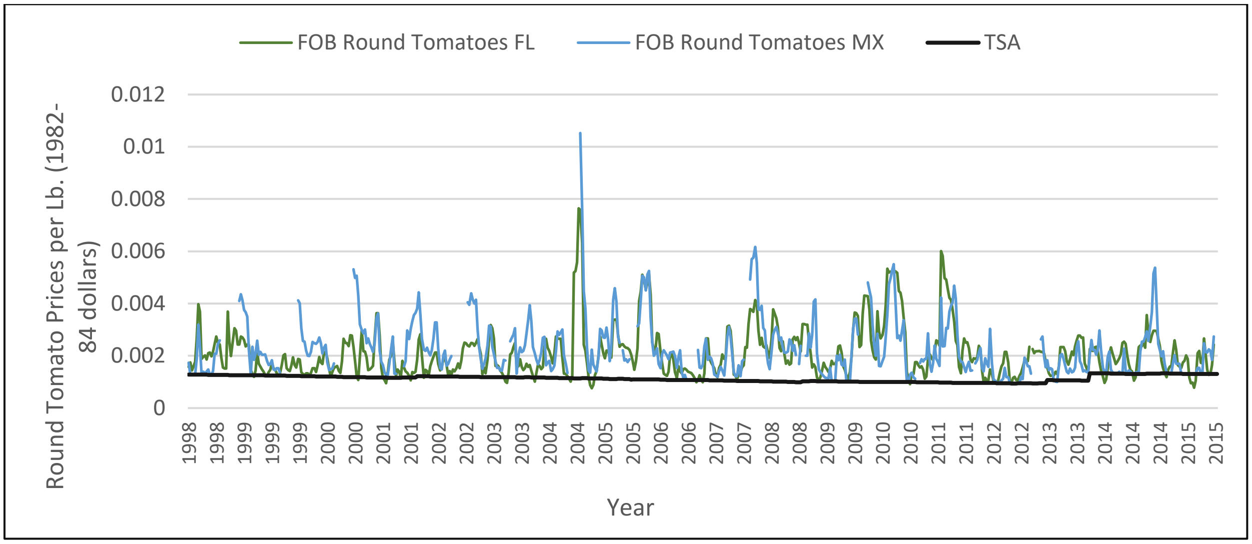


Figure 4.2.2: Comparison of Prices of Mexican and Floridian Round Tomatoes and TSA Reference Price during winter months from 1998 to 2015 (Source: USDA-AMS and Department of Commerce)

4.3 Results for Volume Equations of Fresh Tomatoes

Results of plum and round tomatoes from Mexico and Florida are shown in table 4.3.1, and table 4.3.2 respectively. Termperature parameters estimated for Mexican tomatoes in equations [(21) and (22)] are statistically insignificant (table 4.3.1); however the results of these parameters for tomatoes both plum and round from Florida in equations [(23) and (24)] are statistically significant; all maximum temperatures have positive signs, and the squared maximum temperature are negative (table 4.3.2). These termperature results were expected, as warm termpartures help tomato production until it reaches a turning point temperature where the tomato plants cease production; Table 4.3.3 shows the estimated turning points for termperatures derived from the results in tables 4.3.1 and 4.3.2. The lack of statistical significance of temperatrue results for Mexican tomatoes can be explained by the increased amount of tomatoes produced in greenhouses which controls for changes in termperature, humidity and other weather-related factors.

Precipitation estimates for Mexican tomatoes (plum and round) have positive signs but they are not statistically significant; however for Florida's tomato volume precipitation has negative signs and is statistically significant (tables 4.3.1, and 4.3.2); these results are not surprising, as precipitation levels at the Culiacan weather station on average are 0.26 in per week compared to Ft. Meyer weather station that has an average of 1.07 in per week (see table 3.2.3). In addition, Florida's production of tomatoes is on open fields and the quality of the tomatoes could be affected by rain in the area shrinking the volume of tomatoes from Florida.

The TSA indicator coefficients were expected to have positive signs for volumes of tomatoes from Florida independently of their type, and negative signs for Mexican tomatoes, both plum and round. Contrary to what was expected the results show negative TSA indicator's signs for all tomatoes (plum and round, from both Mexico and Florida); additionally the TSA indicator coeficients for plum tomatoes from Mexico and Florida were statistically significant while the coeficients for round tomatoes from both Mexico and Florida were not. These results suggest that the volume of plum tomatoes from Mexico and Florida react in the same way to lower prices by suppresing their plum tomato volume in the U.S. market, even though the TSA only binds the sales of tomatoes from Mexico.

Table 4.3.1: Least Square Estimates of Volume Equations of Tomatoes from Mexico

Volume of Tomatoes from Mexico				
Dependent Variable	Volume of Plum Tomatoes (VOL_RMX)		Volume of Round Tomatoes (VOL_TMX)	
Explanatory Variables	**Parameter Estimate**	**t Value**	**Parameter Estimate**	**t Value**
Intercept	-47.515	-0.7	-19.532	-0.27
CULTMAX_LAG	1.199	0.79	0.856	0.52
CULTMAX_LAG^2	-0.005	-0.6	-0.004	-0.45
CULPRCP_LAG	-1.169	-0.81	0.632	0.41
TSADUMMY_LAG	-2.069**	-2.1	-3.812	-1.15
IWEEK	123.138***	5.94	290.853***	13.23
IWEEK^2	-578.563***	-5.97	-1375.53***	-13.31
IWEEK^3	746.515***	4.96	1872.398***	11.48
Wald Test Statistic for Seasonality@	112.13 (<.0001)		406.13 (<.0001)	
R-Square	0.2546		0.6266	
Observations Used	448		430	
Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively. @ As χ^2 with 3 degrees of freedom; p-value in parenthesis.				

Table 4.3.2: Least Square Estimates of Volume Equations of Tomatoes from Florida

Volume of Tomatoes from Florida				
Dependent Variable	Volume of Plum Tomatoes (VOL_RFL)		Volume of Round Tomatoes (VOL_TFL)	
Explanatory Variables	**Parameter Estimate**	**t Value**	**Parameter Estimate**	**t Value**
Intercept	-64.221***	-5.57	-371.58***	-5.67
MAYERTMAX_LAG	1.737***	5.94	10.419***	6.25
MAYERTMAX_LAG^2	-0.010***	-5.68	-0.064***	-6.08
MAYERPRCP_LAG	-0.381***	-3.76	-2.820***	-4.76
TSADUMMY_LAG	-1.405***	-5.43	-4.919	-0.85
IWEEK	-24.743***	-3.93	-232.546***	-6.58
IWEEK^2	105.6425***	3.56	1132.732***	6.72
IWEEK^3	-169.41***	-3.64	-1816.87***	-6.82
Wald Test Statistic for Seasonality@	19.96 (.0002)		47.17 (<.0001)	
R-Square	0.163		0.116	
Observations Used	563		537	
Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively. @ As χ^2 with 3 degrees of freedom; p-value in parenthesis.				

Table 4.3.3 Estimated Maximum Temperature Turning Points for Tomato Shipments

Dependent Variable	Temperature Turning point
Plum Tomatoes from Mexico (VOL_RMX)*	119.9°F
Round Tomatoes from Mexico (VOL_TMX)*	107°F
Plum Tomatoes from Florida (VOL_RFL)	86.85°F
Round Tomatoes from Florida (VOL_TFL)	81.40°F

*Values of estimates are not statistically significant.

All of the results of seasonality estimates (IWEEK) were statistically significant. In order to corroborate the significance of the results a joint test (Wald test) for seasonality was performed, where the null hypothesis states that α1=0, α2=0, and α3=0 in each of the equations (21) to (24). All of the results from the joint test show that there is seasonality in the volume availability of tomatoes in the U.S. market (results of the joint test are in tables 4.3.1 and 4.3.2). The estimated seasonality for Mexican and Floridian tomatoes are showed in figures 4.3.1, and 4.3.2 respectively.

Figure 4.3.1 Volume of plum and round tomatoes from Mexico plotted against IWEEKS using parameters of IWEEK, IWEEK^2, and IWEEK^3 from table 4.3.1

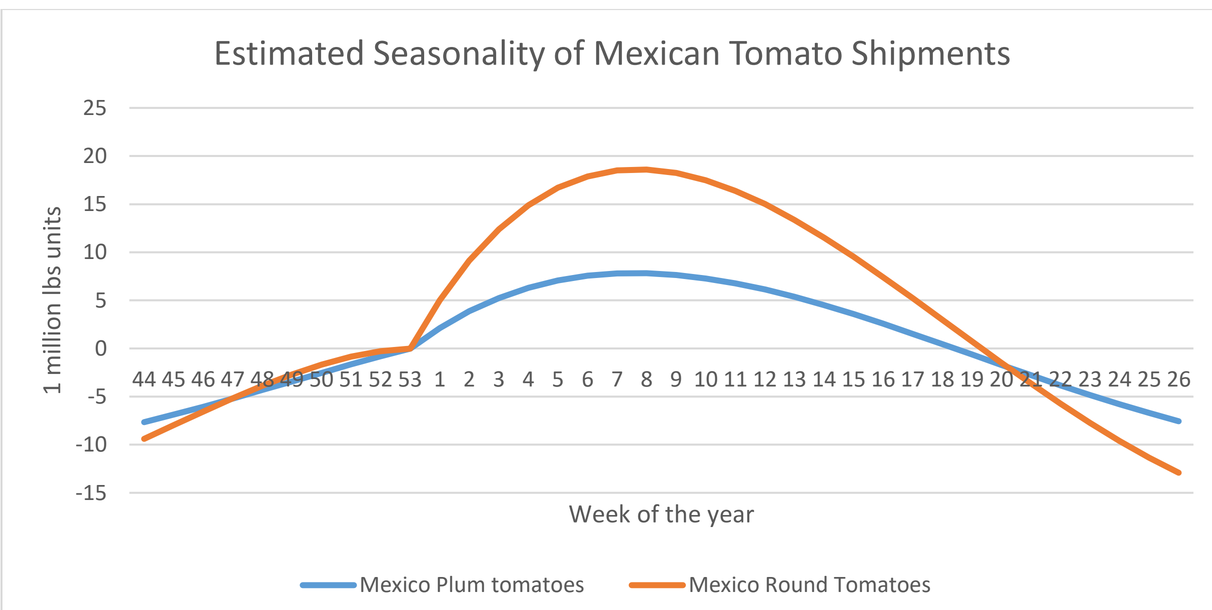
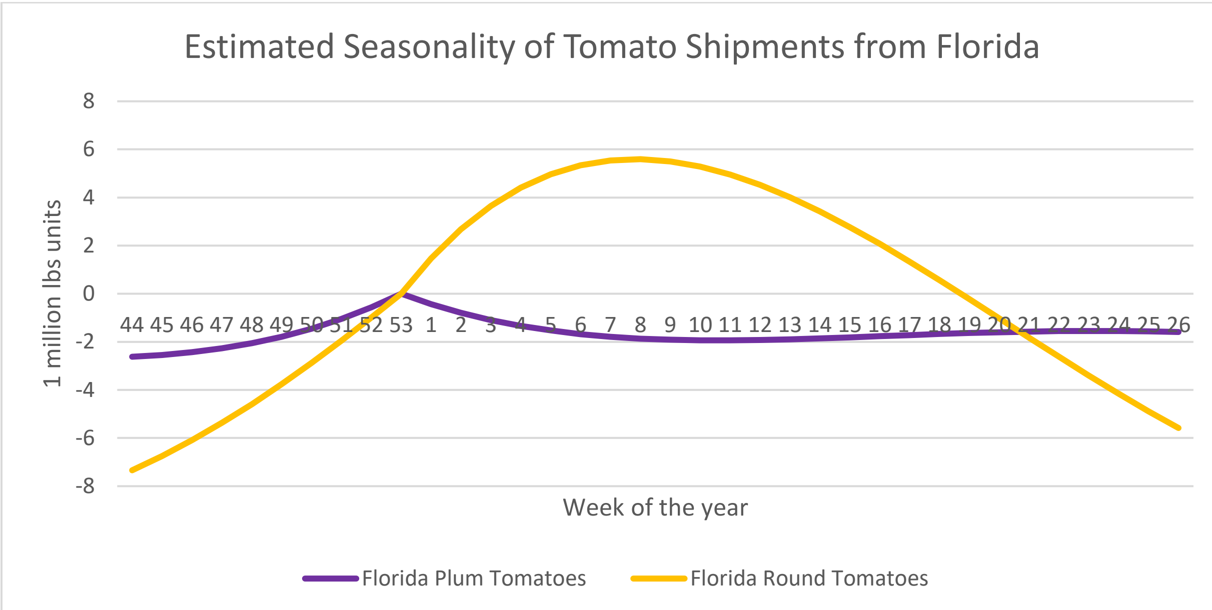


Figure 4.3.2 Volume of plum and round tomatoes from Florida plotted against IWEEKS using parameters of IWEEK, IWEEK^2, and IWEEK^3 from table 4.3.2



Chapter 5: Conclusion

5.1 Conclusions

Tomatoes from Mexico have had a long trade relationship with the United States, and this relation has been full of controversy and disputes. Florida tomato growers have often accused Mexican growers and shippers of flooding the tomato market during the winter months, the main market window for tomatoes from Florida, and lowering prices.

This study shows, as expected, that volumes affect prices both at terminal markets and at shipping points. However, volume of tomatoes from Mexico do not have any influence on prices of round tomatoes from Florida at its main markets (New York, and Chicago terminal markets). Additionally, F.O.B. prices of round tomatoes from Florida are affected by their own volumes; Mexican tomatoes are not statistically significant when quoting prices of Floridian round tomatoes at the shipping point. These findings contradict the frequent accusations of Mexican tomatoes flooding the market by dumping tomatoes and lowering prices.

Additionally, the results of this study suggest that moving tomato production into greenhouses in Mexico has given Mexican growers a competitive advantage over Florida growers by controlling temperature changes and other weather-related factors that can decimate tomato production.

This research, in like manner, found that the floor prices of the Tomato Suspension Agreement have the same effects on tomatoes from Florida and tomatoes from Mexico for both quoting shipping point prices and volume behavior of plum and round tomatoes. This suggests that the measure requested by Florida tomato growers at the Tomato Suspension Agreement affects the tomato market for all tomatoes independently from their origin.

References

Agricultural Marketing Services, Market News, United States Department of Agriculture https://www.marketnews.usda.gov/mnp/fv-home

Agricultural Marketing Services, Marketing Orders and Agreements, United States Department of Agriculture http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateN&page=CommoditiesCoveredUnderSection8e

Ames, Glen C.W., Jeffrey H. Dorfman, and Elisa Soares (1996). Price Analysis of Mexican Tomato Imports: Are Antidumping Duties Warranted? Tri-National Research Symposium, NAFTA and Agriculture: Is the Experiment Working? (1996). http://agrinet.tamu.edu/trade/papers/tomatoes.pdf

Amizkuzno, Joseph and Samuel A. Donkoh (2012). Border Effects of Spatial Price Transmission between Fresh Tomato Markets in Ghana and Burkina-Faso: Any Case for Promotion Trans-Border Trade in West Africa? Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil (2012).

Asci, Serhat, John J. VanSickle, and Dan Cantliffe (2013). The Potential for Greenhouse Tomato Production Expansion in Florida – Selected Paper prepared for presentation at the Southern Agricultural Economics Association (SAEA) Annual Meeting, Orlando, FL (February 2013). http://ageconsearch.umn.edu/bitstream/143095/2/SAEA-2013-The%20Potential%20for%20Greenhouse%20Tomato%20Production%20Expansion%20in%20Florida.pdf

Boriss, Hayley, and Henrich Brunke (2005). Commodity Profile: Tomatoes, fresh market. Agricultural Issues Center, University of California. Agricultural Marketing Resource Center (October 2005). http://aic.ucdavis.edu/profiles/FreshTomatoes-2005.pdf

Bureau of Labor Statistics, Consumer Price Index, United States Department of Labor. CPI Databases. https://www.bls.gov/cpi/data.htm

Cook, Roberta (2014). Fresh Tomato Trends in the N. American Market. Department of Agriculture and Resource Economics – University of California Davis for America Trades Produce Conference at Tubac, AZ (March 13, 2014).

http://arefiles.ucdavis.edu/uploads/filer_public/2014/05/19/fpaacooktomatofinal140313.pdf

Cook, Roberta, and Linda Calvin (2005). Greenhouse Tomatoes Changes the Dynamics of the North American Fresh Tomato Industry. United States Department of Agriculture – Economic Research Service. Economic Research Report No. (ERR-2) 86 pp, April 2005. https://www.ers.usda.gov/webdocs/publications/err2/15309_err2_1_.pdf

Department of Commerce. Suspension of Antidumping Investigation: Fresh Tomatoes from Mexico (March 4, 2013). http://enforcement.trade.gov/tomato/2013-agreement/documents/Mexico-Tomatoes-Agreement-20130304.pdf

Department of Commerce. Suspension of Antidumping Investigation: Fresh Tomatoes from Mexico. Weight Charts (March 4, 2013). http://enforcement.trade.gov/tomato/2013-agreement/documents/20130304-Box-Weight-Charts.pdf

Diaz Belmontes, Alfredo (2015). Horticultura Protegida en México – Retos, Amenazas Perspectivas. Asociación Mexicana de Horticultura Protegida (AMHPAC), November 09, 2015. http://www.amhpac.org/es/index.php/descargas/item/situacion-actual-de-la-industria-de-agricultura-protegida

Economic Research Service, United States Department of Agriculture. Fresh Tomato Industry (February 03, 2016). http://www.ers.usda.gov/topics/crops/vegetables-pulses/tomatoes.aspx

Economic Research Service, United States Department of Agriculture. Greenhouse Tomatoes Change the Dynamics of the North American Fresh Tomato Industry / ERR-2. http://www.ers.usda.gov/media/307185/err2d_1_.pdf

Florida Department of Agriculture and Consumer Services. Florida Agriculture by the Numbers (2011). https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Annual_Statistical_Bulletin/FL_Agriculture_Book/2011/2011%20FL%20Ag%20by%20the%20Numbers.pdf

Florida Tomato Committee. https://www.floridatomatoes.org/

Flores, Dulce, and Joe Lopez (2015). Mexico, Tomato Annual, Mexican Tomato Production Up Slightly. United States Department of Agriculture – Foreign Agricultural Service - Global Agricultural Information Network. GAIN Report Number: MX5024 (June 8, 2015).

http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Tomato%20Annual_Mexico%20City_Mexico_6-8-2015.pdf

International Trade Administration, Enforcement and Compliance, United States Department of Commerce. Fresh Tomatoes from Mexico: Suspension Agreement (March 07, 2011). http://ia.ita.doc.gov/tomato/

LeStrange, Michelle, Wayne L. Schrader, and Timothy K. Hartz (2000). Fresh-Market Tomato Production in California, University of California, Division of Agriculture and Natural Resources, Publication 8017. http://anrcatalog.ucanr.edu/pdf/8017.pdf

National Agricultural Statistics Service, Florida Field Office, United States Department of Agriculture. 2016 Annual Statistical Bulletin – Vegetables Melons and Berries. https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Annual_Statistical_Bulletin/2016/E1thru18Veg-2016.pdf

National Institute of Food and Agriculture, United States Department of Agriculture. Crop Profile for Tomatoes in Florida (2006). https://ipmdata.ipmcenters.org/documents/cropprofiles/FLtomatoes.pdf

National Oceanic and Atmospheric Administration (NOAA) – National Centers for Environmental Information. https://www.ncdc.noaa.gov/cdo-web/search

Padilla-Bernal, Luz, and Dawn D. Thilmany (2000). Mexican-U.S. Fresh Tomato Trade: An Analysis of Volume, Prices and Transaction Costs. WAEA meetings in Vancouver, BC (July 2000).

Padilla-Bernal, Luz, Dawn D. Thilmany, and Maria L. Loureiro (2003). An Empirical Analysis of Market Integration and Efficiency for U.S. Fresh Tomato Markets. Journal of Agricultural and Resource Economics, Vol. 28, No. 3 (December 2003), pp. 435-450.

Palma, Marco, Flynn Adcock, Parr Rosson, and Daniel Hanselka (2013). Economic Impacts of Increased U.S. Imports of Fresh Produce from Mexico by 2020 – CNAS Issue Brief 2013-04. Department of Agricultural Economics, Texas A&M University/Texas A&M AgriLife Extension Service/ Texas A&M AgriLife Research (September 2013).

Rudman, Judy, and Bryan Wright (2013). Tomato Suspension Agreement Explained as Amended March 4, 2013. USDA AMS Fruit and Vegetable Program and USDOC ITA Import Administration (2013). http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5103314

Thompson, Gary D., Satheesh V. Aradhyula, and Russell Tronstad (2005). Modeling Florida Fresh Tomato Supply Response: Composite Switching Regressions with Variable Weather-Determined Lags. American Agricultural Economics Association (2005).

United States Energy Information Administration (EIA). http://www.eia.gov/beta/MER/index.cfm?tbl=T09.04#/?f=M

Ward, Ronald W. (1982). Asymmetry in Retail, Wholesale, and Shipping Point Pricing for Fresh Vegetables. American Journal of Agricultural Economics, Vol. 64, No. 2 pp. 205- 212 (May, 1982).